H1020 9427H

CONTROL DATA

# Student Training Manual for

## 9427H CARTRIDGE DISK DRIVE

## REVISION RECORD

| REVISION | DESCRIPTION |
|---|---|
| A | |
| 5/20/81 | First Printing, 5/22/81 |
| | |
| | |
| |

This manual contains all necessary Student Materials for the subject course and is to be retained by the student.

The following sections will normally be included in this manual. However, if they are not included, it is because they have not been developed at this time.

- Course and Learning Objectives - The Course Objectives identify student performance, and the Learning Objectives identify the steps needed to accomplish the Course Objectives.
- Course Chart - This is a layout of the course on a daily basis, and can be used by the student in planning his time in the course.

  Handouts - These are normally drawings that are used for clarification or to provide supplementary information.
- Workbook - This is assigned by the instructor either as homework or work to be done in the lab while waiting for machine time. The workbook is not assigned as "Busy Work," but is an integral part of the course.
- Student Lab Manual - This is used by the student as a guide in the lab. There may be projects to perform, questions to answer or reading assignments to complete, and like the workbook this is another important element of the course and should be completed in a timely manner.

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|---|---|
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| Student Lab Manual | SLM-1 to SLM-11 |
| Test | TI-1 to TI-3 |
| Field Test Unit | FTU-1 to FTU-21 |

## OBJECTIVES

| | | |
|---|---|---|
| 1 | GIVEN: | Any major component of the disk drive. |
| | THE STUDENT WILL: | Identify that major component and state its basic purpose. |
| | CRITERIA: | This must be performed with 100% accuracy. |
| 1.1 | GIVEN: | 9427H disk drive<br>Hardware Maintenance Manual #77614950<br>Standard hand tools. |
| | THE STUDENT WILL: | Locate and identify the major components of the disk drive in accordance with lab assignment. |
| | CRITERIA: | This task must be performed with 90% accuracy on day 1 lab sheet. |
| 1.2 | GIVEN: | A functional block diagram of the disk drive. |
| | THE STUDENT WILL: | State the function of each major component of the drive. |
| | CRITERIA: | This must be performed with 90% accuracy. |
| 2.0 | GIVEN: | A 9427H disk drive<br>Hardware Maintenance Manual #77614950<br>Scratch disk pack |
| | THE STUDENT WILL: | Perform initial checkout and startup procedures. |
| | CRITERIA: | This will be performed in accordance with Section 3.13 of the Hardware Maintenance Manual #77614950. |
| 2.1 | GIVEN: | A 9427H operators control panel diagram. |
| | THE STUDENT WILL: | State the function of each switch and indicator. |
| | CRITERIA: | This must be performed with 100% accuracy. |
| 2.2 | GIVEN: | A 9427H disk drive<br>Hardware Maintenance Manual #77614950<br>Hardware Product Configurator (HPC) package |
| | THE STUDENT WILL: | Set the option switches on the Logic Cards. |
| | CRITERIA: | This must be performed with 100% accuracy and in accordance with the HPC package. |

| | | |
|---|---|---|
| 3.0 | GIVEN: | A block diagram of the 9427H disk drive. |
| | THE STUDENT WILL: | State the function of each component of the block diagram and associated signals. |
| | CRITERIA: | This must be performed with 90% accuracy. |
| 3.1 | GIVEN: | A 9427H power distribution block diagram. |
| | THE STUDENT WILL: | Explain how the voltages are distributed in the disk drive. |
| | CRITERIA: | This must be performed with 90% accuracy. |
| 3.2 | GIVEN: | A powerup/first seek flowchart. |
| | THE STUDENT WILL: | Explain the operations involved to get the disk drive to the "Ready" condition. |
| | CRITERIA: | This must be done with no more than 3 instructor assists. |
| 3.3 | GIVEN: | A 9427H SERVO system block diagram. |
| | THE STUDENT WILL: | Explain how the servo system positions the R/W heads. |
| | CRITERIA: | This must be performed with 90% accuracy and is to include the necessary signals generated by the controller and up to "On Cylinder" being sent to the controller. |
| 3.3.1 | GIVEN: | A position transducer block diagram. |
| | THE STUDENT WILL: | State the two signals generated by the position transducer and the function of each. |
| | CRITERIA: | This must be performed with 100% accuracy. |
| 3.4 | GIVEN: | A block diagram of the Data Recovery board |
| | THE STUDENT WILL: | State the operation performed by the Data Recovery board. |
| | CRITERIA: | This must be performed with no more than three instructor assists. |
| 3.5 | GIVEN: | A Hardware Maintenance Manual #77614950. |
| | THE STUDENT WILL: | Locate the table of Input/Output lines and the function of each. |
| | CRITERIA: | This must be performed with 100% accuracy. |

| | | |
|---|---|---|
| 4.0 | GIVEN: | A 9427H disk drive<br>Hardware Maintenance Manual #77614950<br>Standard hand tools |
| | THE STUDENT WILL: | Perform preventive maintenance on the 9427H disk drive. |
| | CRITERIA: | Successful completion of this task will be demonstrated during day 3 lab sheet. |
| 4.1 | GIVEN: | A 9427H disk drive<br>Hardware Maintenance Manual #77614950<br>Standard hand tools |
| | THE STUDENT WILL: | Perform level 3 preventive maintenance on the disk drive. |
| | CRITERIA: | This must be performed in accordance with Section 6 of the Hardware Maintenance Manual #77614950. |
| 4.2 | GIVEN: | A 9427H disk drive<br>Hardware Maintenance Manual #77614950<br>Standard hand tools |
| | THE STUDENT WILL: | Perform level 5 preventive maintenance on the disk drive. |
| | CRITERIA: | This must be performed in accordance with Section 6 of the Hardware Maintenance Manual #77614950. |
| 4.2.1 | GIVEN: | A Hardware Maintenance Manual #77614950 |
| | THE STUDENT WILL: | Locate the maintenance index and schedule |
| | CRITERIA: | This must be performed with 100% accuracy. |
| 5.0 | GIVEN: | A 9427H disk drive<br>Hardware Maintenance Manual #77614950<br>Field Test Unit TB-118A and Operating Instructions<br>All necessary tools and test equipment |
| | THE STUDENT WILL: | Perform corrective maintenance on the disk drive by isolating instructor induced faults to a replaceable PWA or subassembly. |
| | CRITERIA: | Each malfunction must be corrected within one hour. |

| | | |
|---|---|---|
| 5.1 | GIVEN: | A 9427H disk drive<br>Hardware Maintenance Manual #77614950<br>Standard hand tools and 9427H maintenance tools<br>Student lab manual |
| | THE STUDENT WIll: | Perform the removal and replacement of the components as outlined in the Student Lab Manual. |
| | CRITERIA: | This will be performed in accordance with Section 6 of the Hardware Maintenance Manual #77614950. |
| 5.2 | GIVEN: | A 9427H disk drive<br>Hardware Maintenance Manual #77614950<br>Field Test Unit TB-118A and Operating Instructions<br>All necessary Tools and Test Equipment. |
| | THE STUDENT WILL: | Perform the test and adjustments on the disk drive. |
| | CRITERIA: | This must be performed in accordance with Section 6 of the Hardware Maintenance Manual #77614950 |
| 6.0 | GIVEN: | A 9427H disk drive<br>Hardware Maintenance Manual #77614950<br>All necessary tools and test equipment |
| | THE STUDENT WILL: | Install and check out the 9427H. This will include meeting site requirements, unpackaging, power hook-ups and electrical and mechanical adjustments. |
| | CRITERIA: | Evidence of successful completion will be a properly operating disk drive. |
| | NOTE: | The ideal situation would be for this objective to be performed, however, due to equipment requirement this objective will be measured by the students' attainment of the other objectives. |

9427 Hawk
Course Chart

| | DAY 1 | DAY 2 | DAY 3 | DAY 4 | DAY 5 |
|---|---|---|---|---|---|
| 1 | Course Introduction | Review | Review | Review | |
| 2 | Publication Orientation | Functional Analysis | Operational Lab | Maintenance Lab | |
| 3 | Introduction to 9427H | | | | |
| 4 | Physical Description | | Interface | | |
| 5 | | | Maintenance Strategy | | |
| 6 | Introductory Lab | Field Test Unit | Preventive/ Corrective Maintenance Lab | Course Exam | |
| 7 | | | | | |
| 8 | Review and Assignment | Review and Assignment | Review and Assignment | | |


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## HANDOUT/TRANSPARENCY INDEX


| | |
|---|---|
| HO/TR1 | Course Chart |
| HO/TR2 | Functional Block Diagram |
| HO/TR3 | Mounting Configurations |
| HO/TR4 | Controls and Indicators |
| HO/TR5 | Major Assemblies - Top View |
| HO/TR6 | Major Assemblies - Bottom View |
| HO/TR7 | Disk Rotational Mechanism |
| HO/TR8 | Spindle Assembly |
| HO/TR9 | Actuator Assembly |
| HO/TR10 | Position Transducer |
| HO/TR11 | Head Assembly |
| HO12 | Head Options |
| HO13/TR12 | Primary/Motor Power Distribution |
| HO14/TR13 | DC Handling |
| HO15/TR14 | Sin and Cos Generation |
| HO16/TR15 | Count Pulse Generation |
| HO17/TR16 | Simplified Cylinder Address Difference Generator |
| HO18/TR17 | Analog Amp and Inverter |
| HO19/TR18 | Summing Amplifier |
| HO20/TR19 | Power Amplifier |
| HO21/TR20 | Servo System Block Diagram |
| HO22-HO25 | Power Up - First Seek Operation |
| HO26-HO27 | RTZ Seek |
| HO28-HO30 | Operational Seek |
| HO31/TR21 | Digital Phase Lock Loop Separator |
| HO32/TR22 | R/W/E Operation |
| HO33/TR23 | Fault Logic |
| HO34-HO38 | Hawk MNEMONIC Listing |

# 9427 Hawk
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| 7 | | | | | |
| 8 | Review and Assignment | Review and Assignment | Review and Assignment | | |


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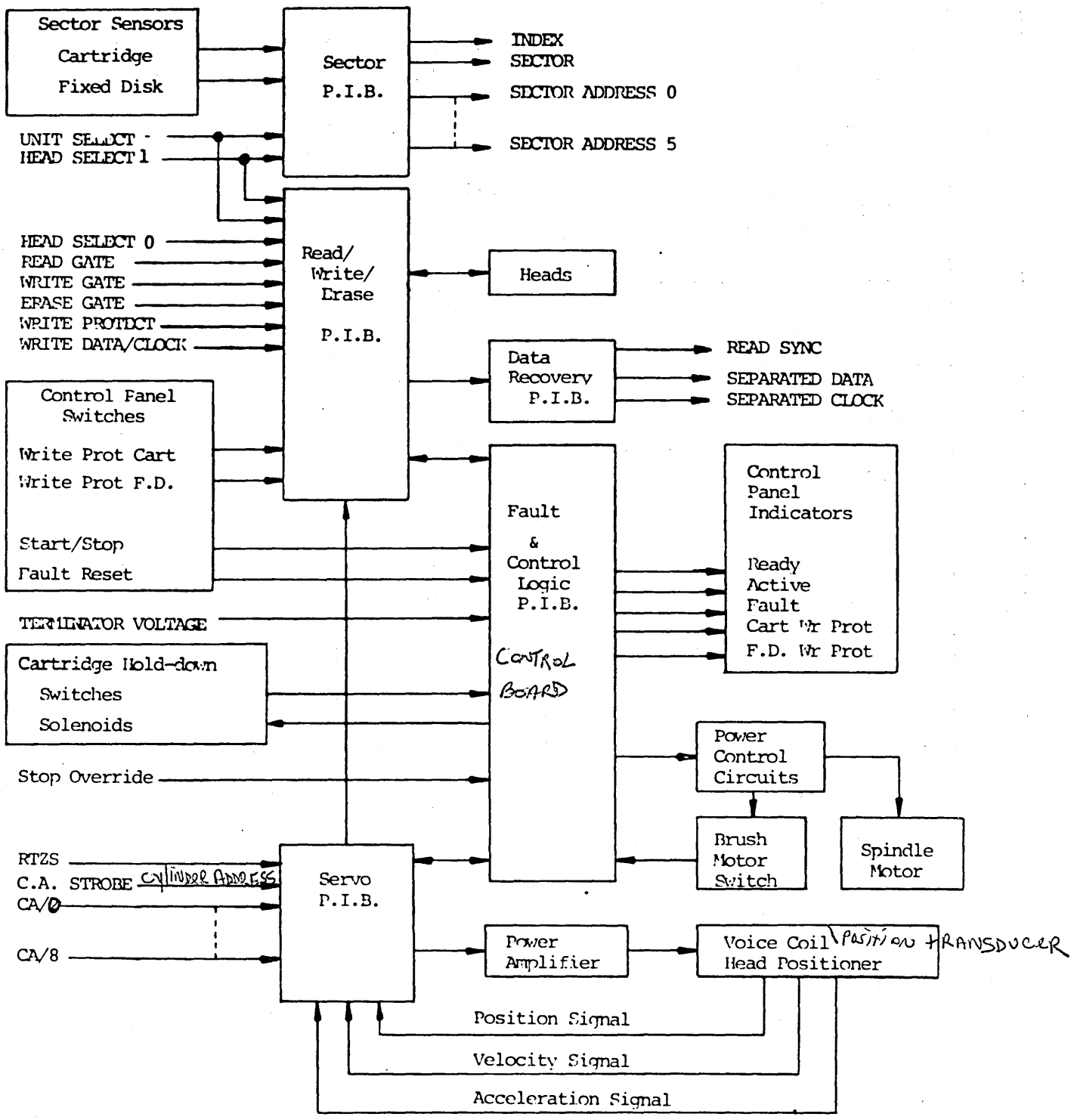
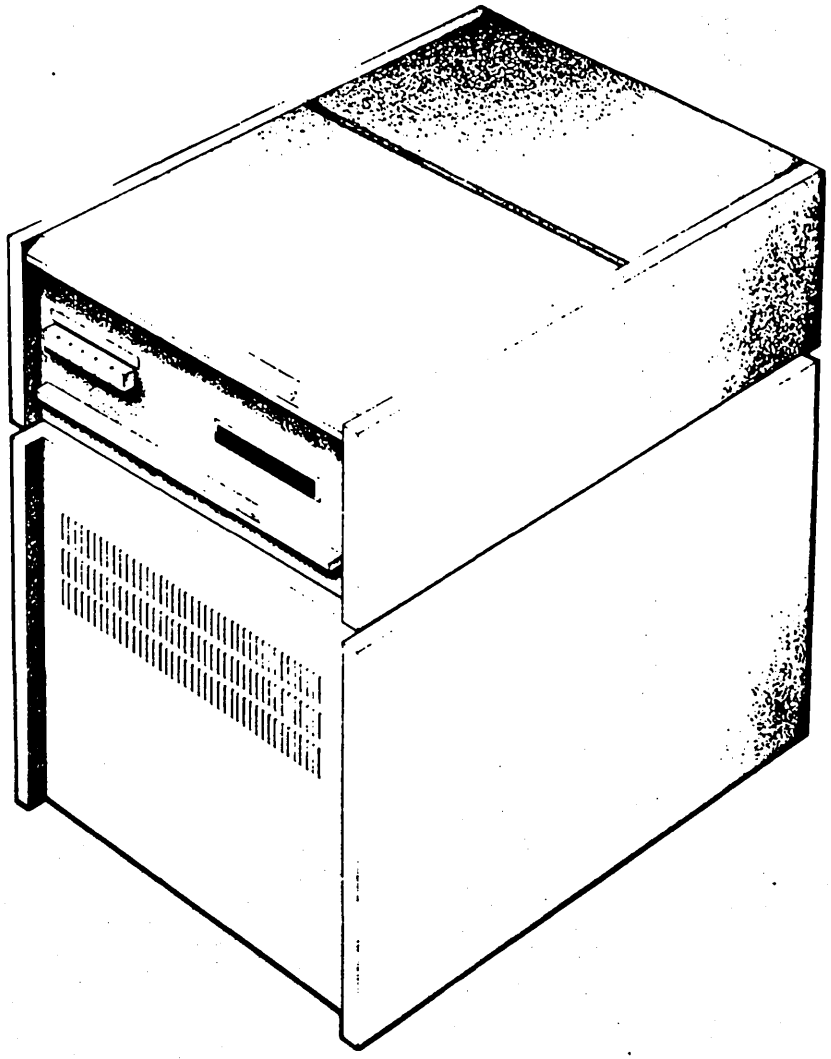
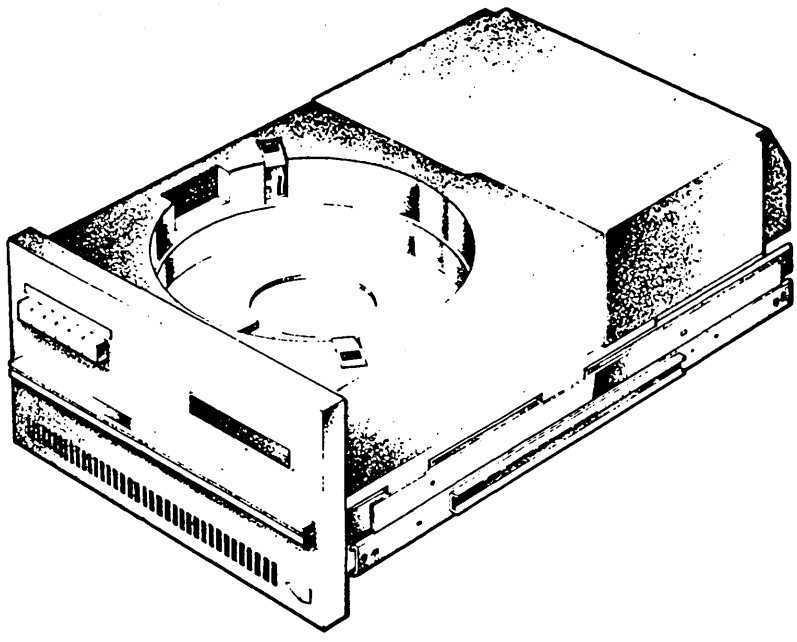
# CDD BLOCK DIAGRAM



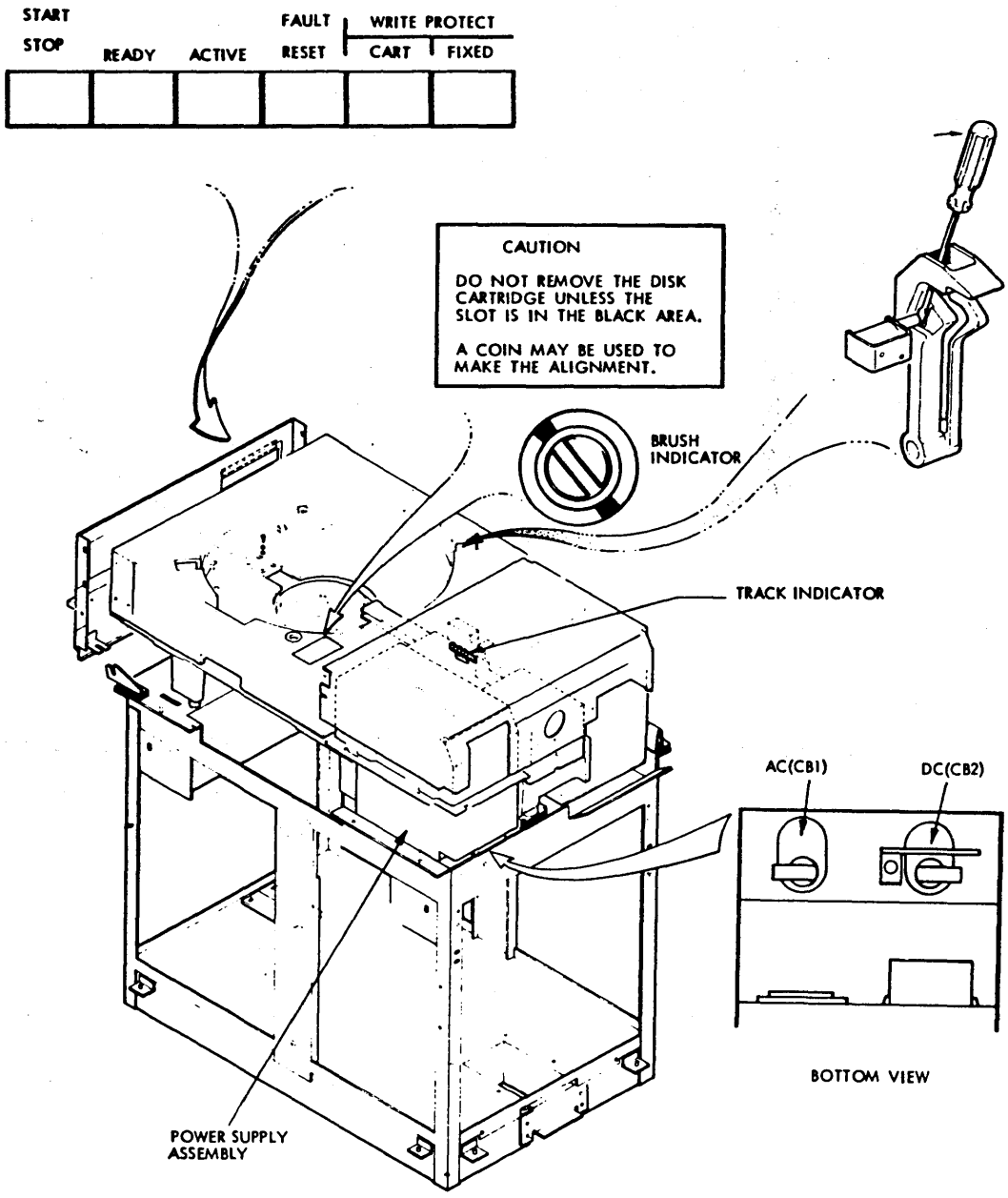


MODEL 9427 CARTRIDGE DISK DRIVE (CABINET MOUNT)

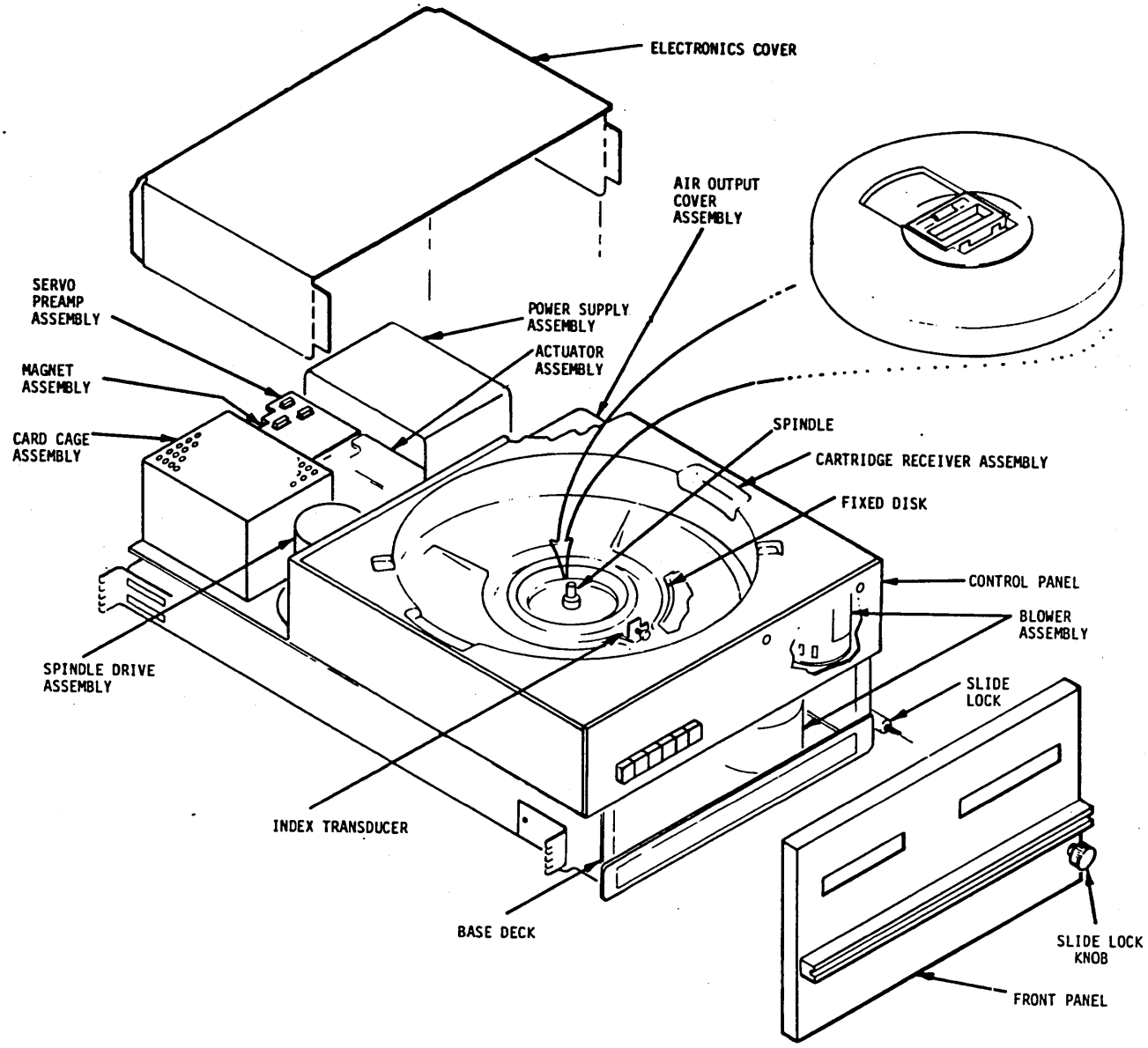


MODEL 9427 CARTRIDGE DISK DRIVE (RACK MOUNT)

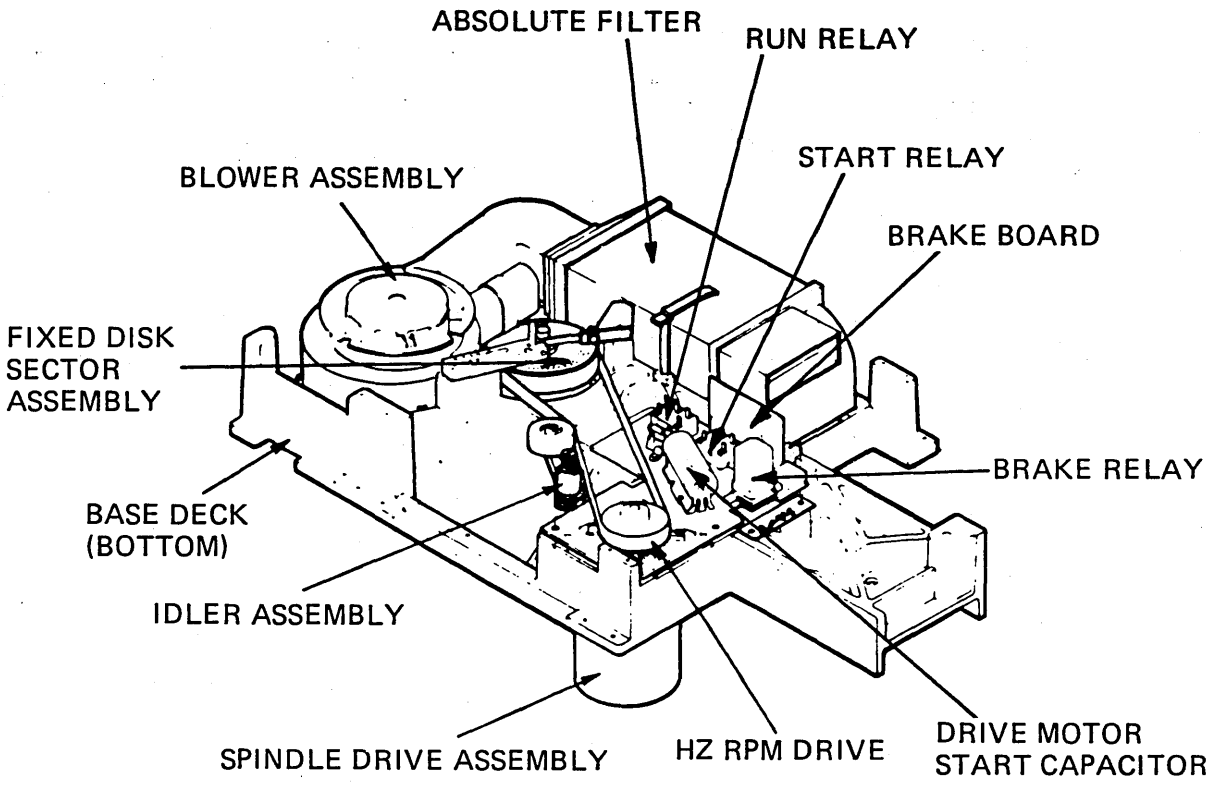
# CONTROLS AND INDICATORS



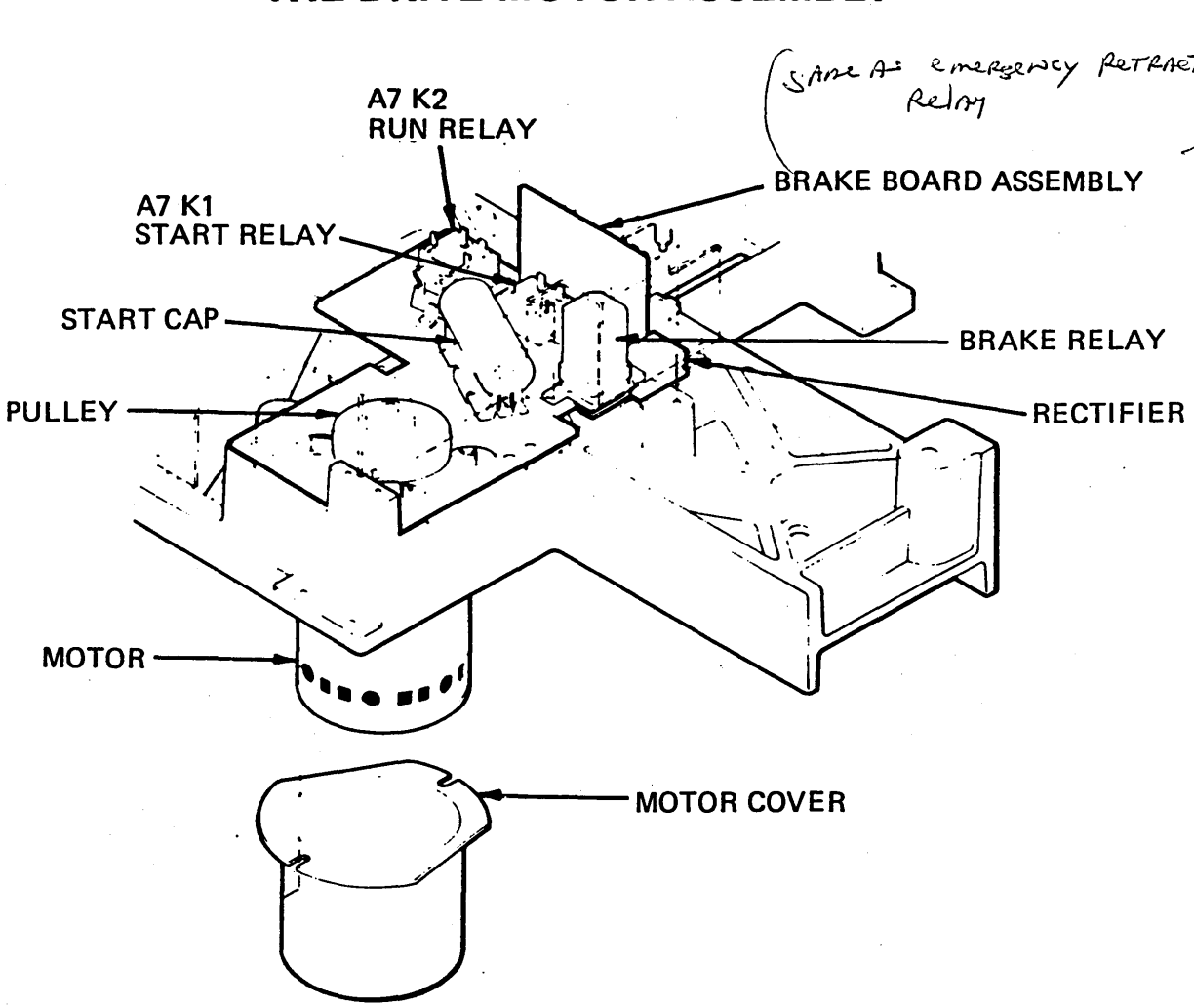
# MAJOR ASSEMBLIES—TOP VIEW



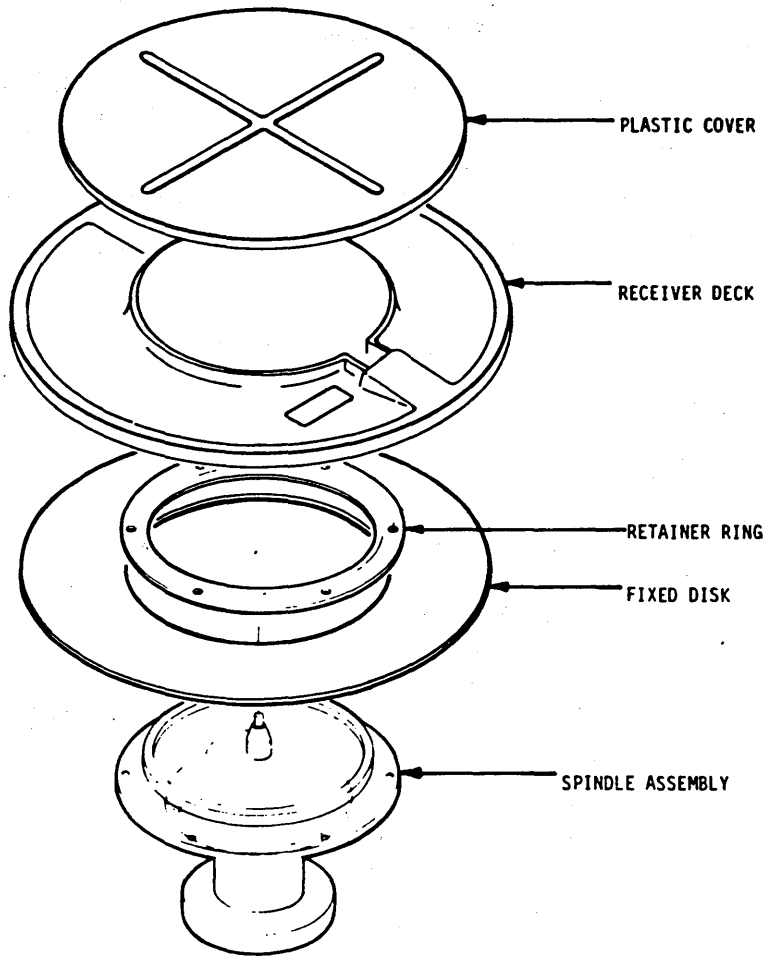
# MAJOR ASSEMBLIES—BOTTOM VIEW



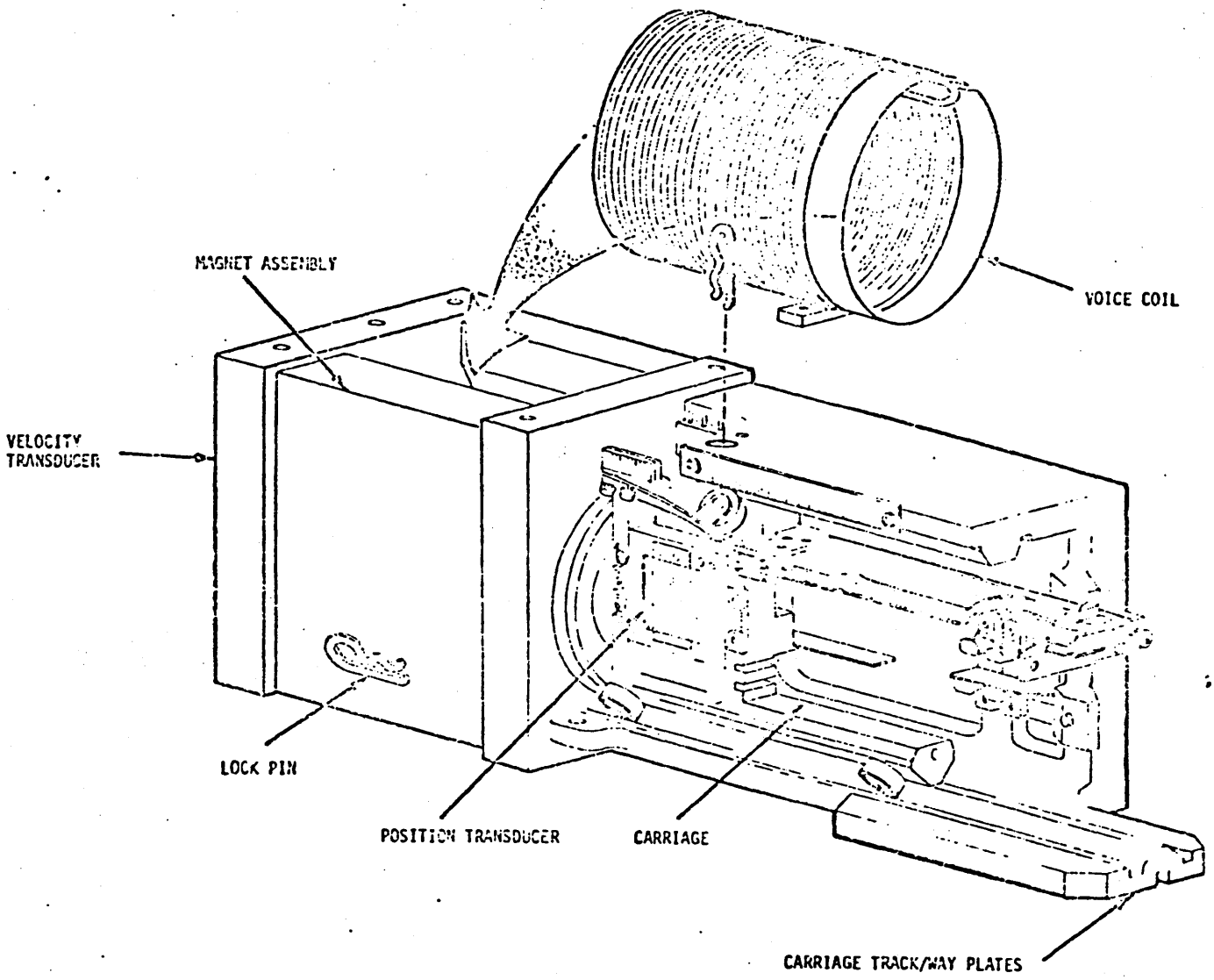
# THE DRIVE MOTOR ASSEMBLY



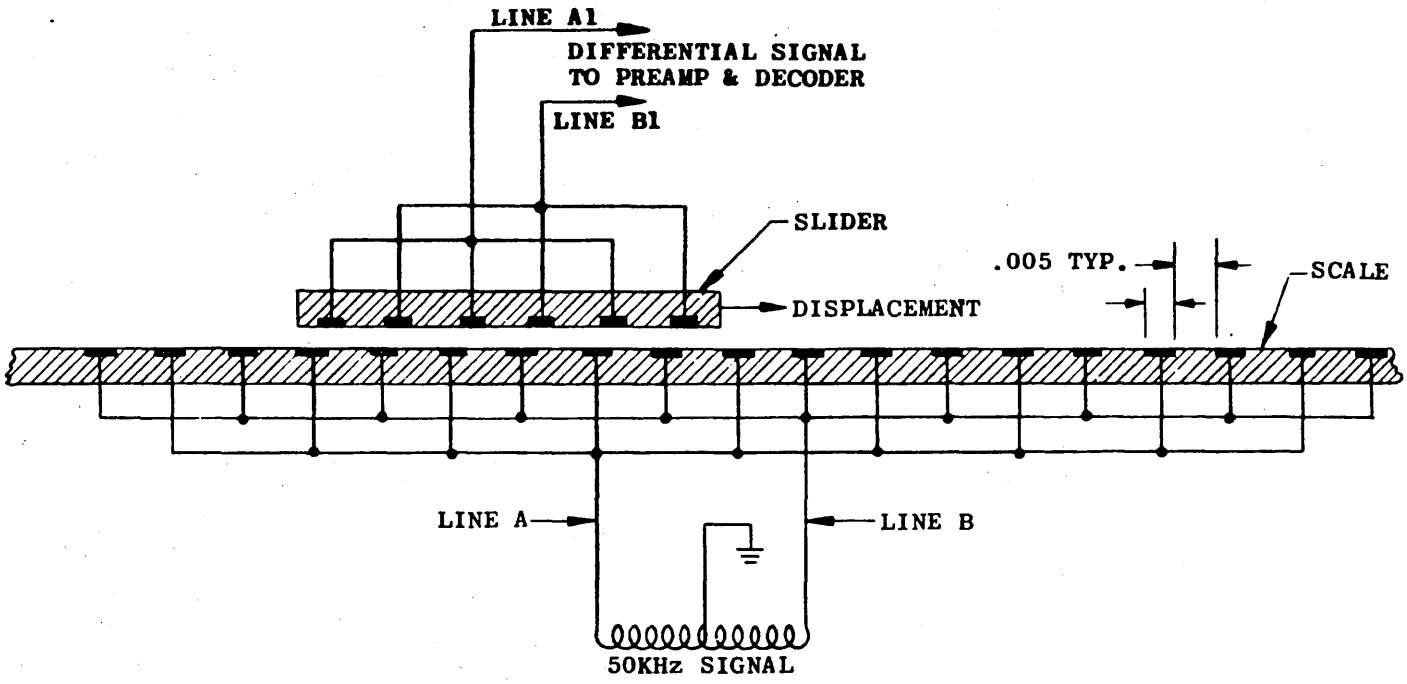
# THE SPINDLE ASSEMBLY



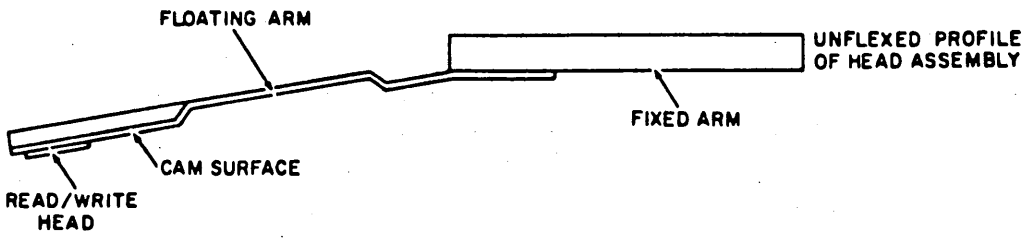
# ACTUATOR ASSEMBLY

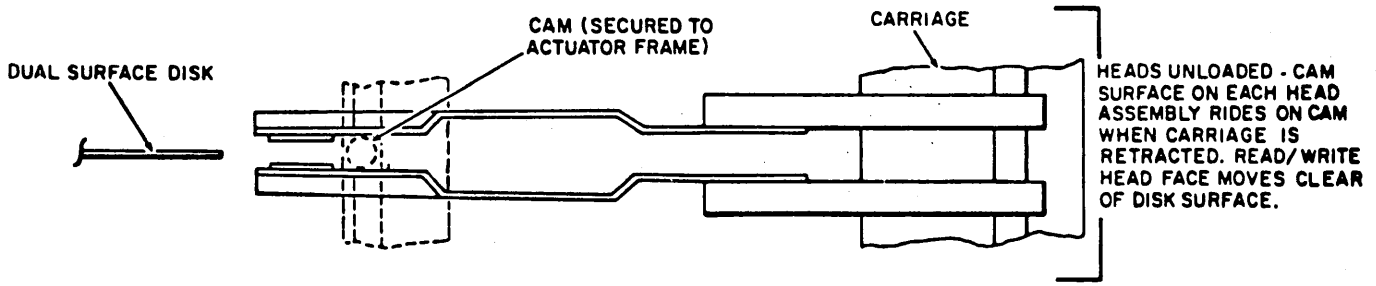


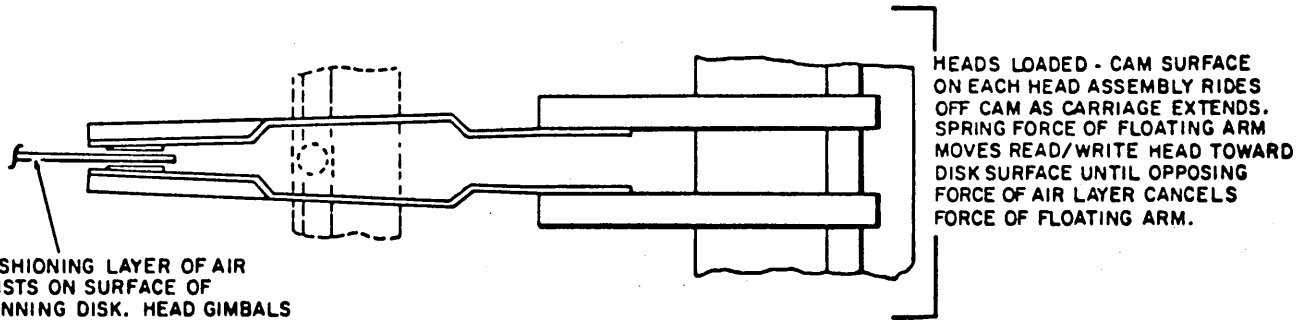
# THE POSITION TRANSDUCER



# HEAD LOADING





DUAL SURFACE DISK
CAM (SECURED TO ACTUATOR FRAME)
CARRIAGE
HEADS UNLOADED - CAM SURFACE ON EACH HEAD ASSEMBLY RIDES ON CAM WHEN CARRIAGE IS RETRACTED. READ/WRITE HEAD FACE MOVES CLEAR OF DISK SURFACE.

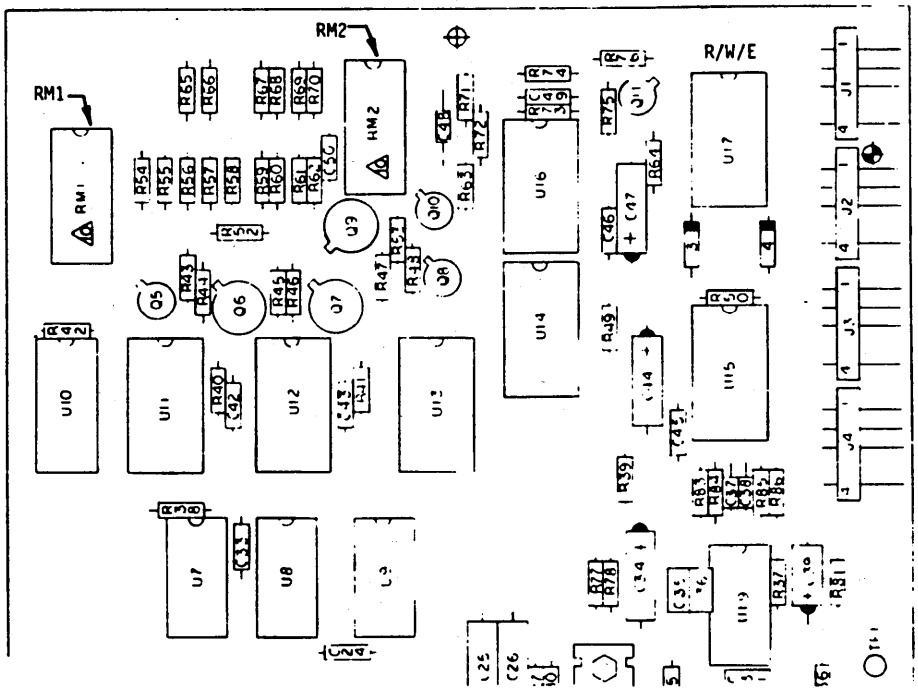

HEADS LOADED - CAM SURFACE ON EACH HEAD ASSEMBLY RIDES OFF CAM AS CARRIAGE EXTENDS. SPRING FORCE OF FLOATING ARM MOVES READ/WRITE HEAD TOWARD DISK SURFACE UNTIL OPPOSING FORCE OF AIR LAYER CANCELS FORCE OF FLOATING ARM.
CUSHIONING LAYER OF AIR EXISTS ON SURFACE OF SPINNING DISK. HEAD GIMBALS COMPENSATE FOR DISK VARIATIONS.

PRE ERASED - erase first the write

STRADDLE ERASE -

# HEAD OPTIONS

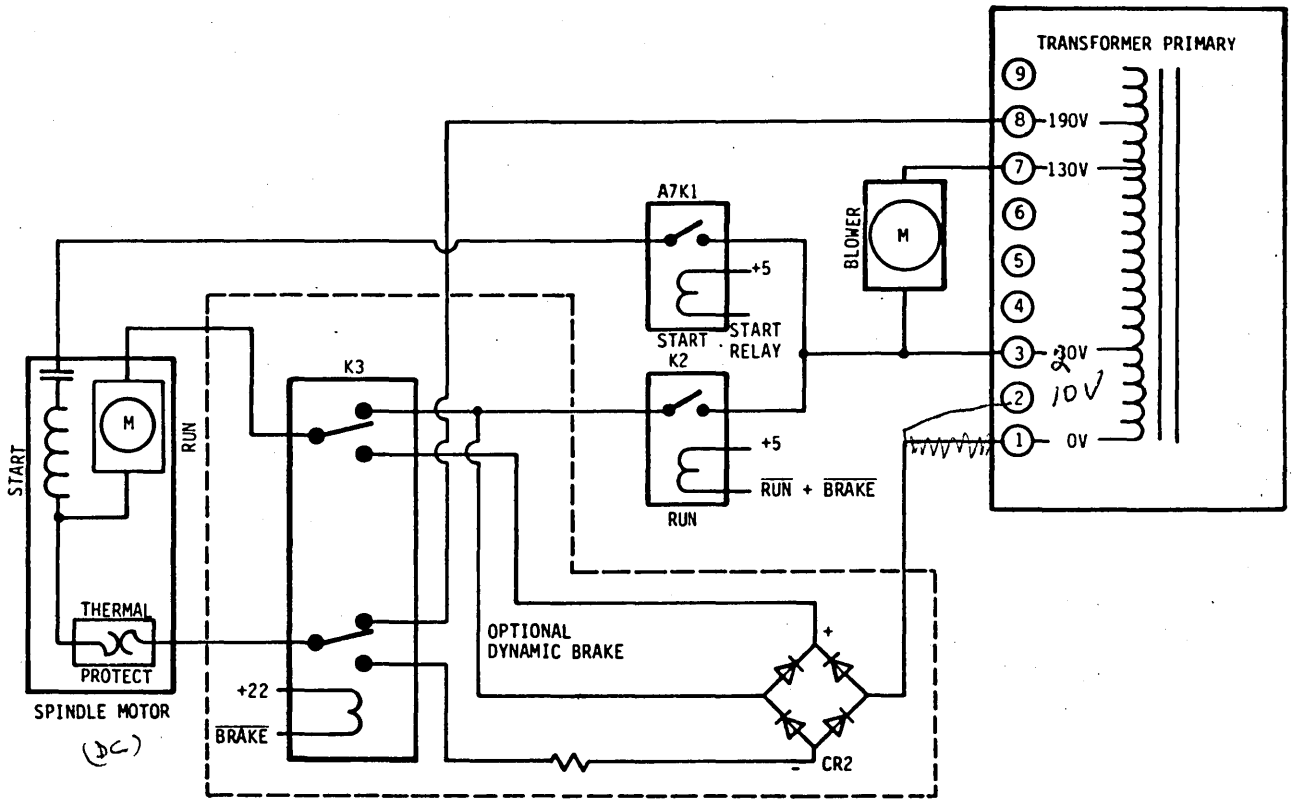
| TRACKS PER INCH/SPEED | OLD PART # | | NEW PART # | |
|---|---|---|---|---|
| | UPPER | LOWER | UPPER | LOWER |
| 100 TPI PE 2400 RPM | 70590203 | 70590202 | 70590207 | 70590206 |
| 100 TPI SE 2400 RPM | 70590303 | 70590302 | 70590305 | 70590304 |
| 100 TPI SE 1500 RPM | 70590301 | 70590300 | 70590307 | 70590306 |
| 200 TPI PE 2400 RPM | 70590205 | 70590204 | 70590209 | 70590208 |
| 200 TPI SE 1500 RPM | 75037503 | 75037502 | 75037507 | 75037506 |
| 200 TPI SE 2400 RPM | 75037501 | 75037500 | 75037505 | 75037504 |



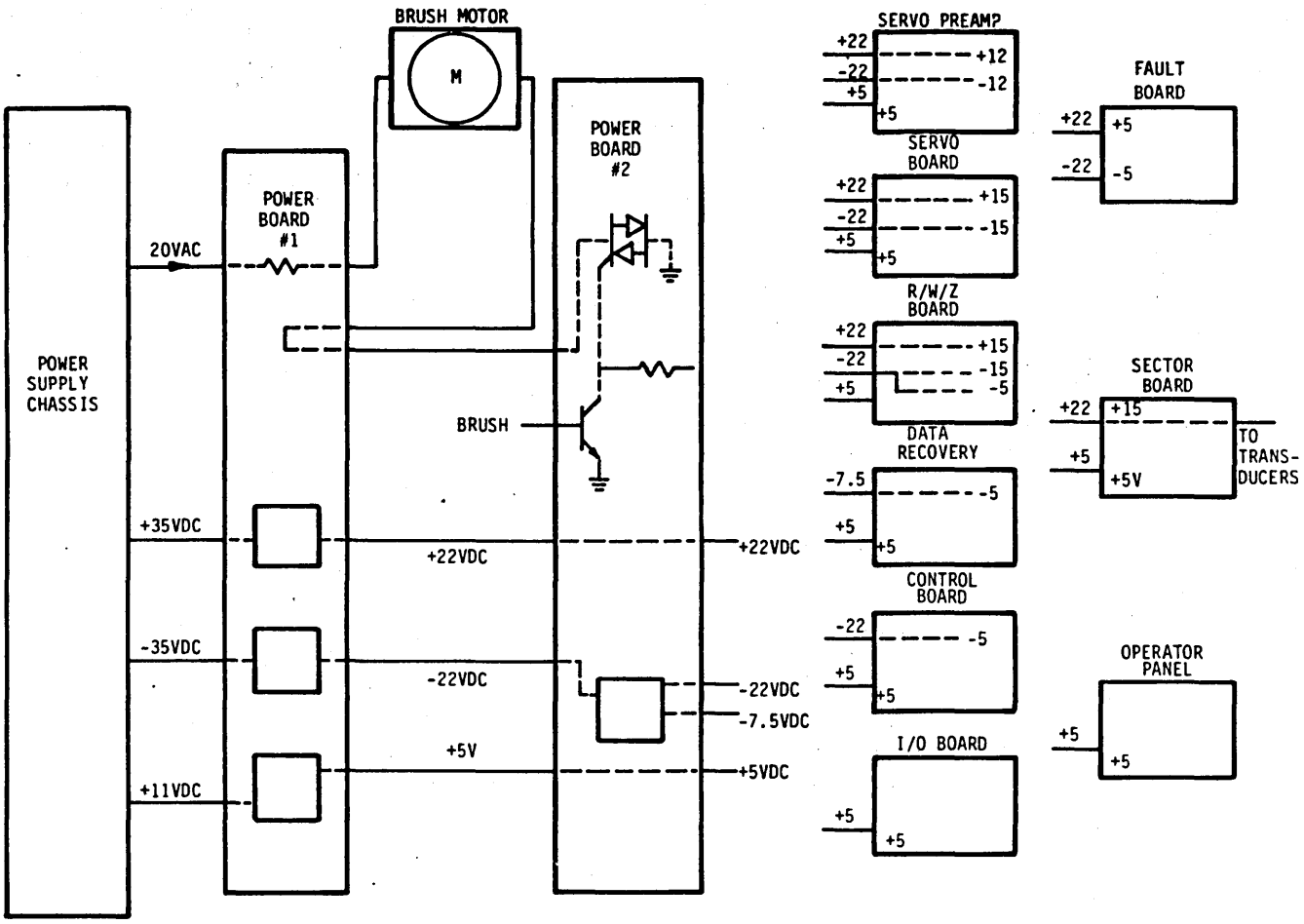

POSITION OF KEY (OR WHITE DOT) ON RM1 & RM2 ( ↑UP ↓DOWN)

| | RM1 | RM2 |
|---|---|---|
| 100 TPI PE | 75300100 | 75300100 |
| 100 TPI SE | BLANK | 75300100 |
| 200 TPI PE | 75300100 | BLANK |
| 200 TPI SE | 75300200 | 75300200 |

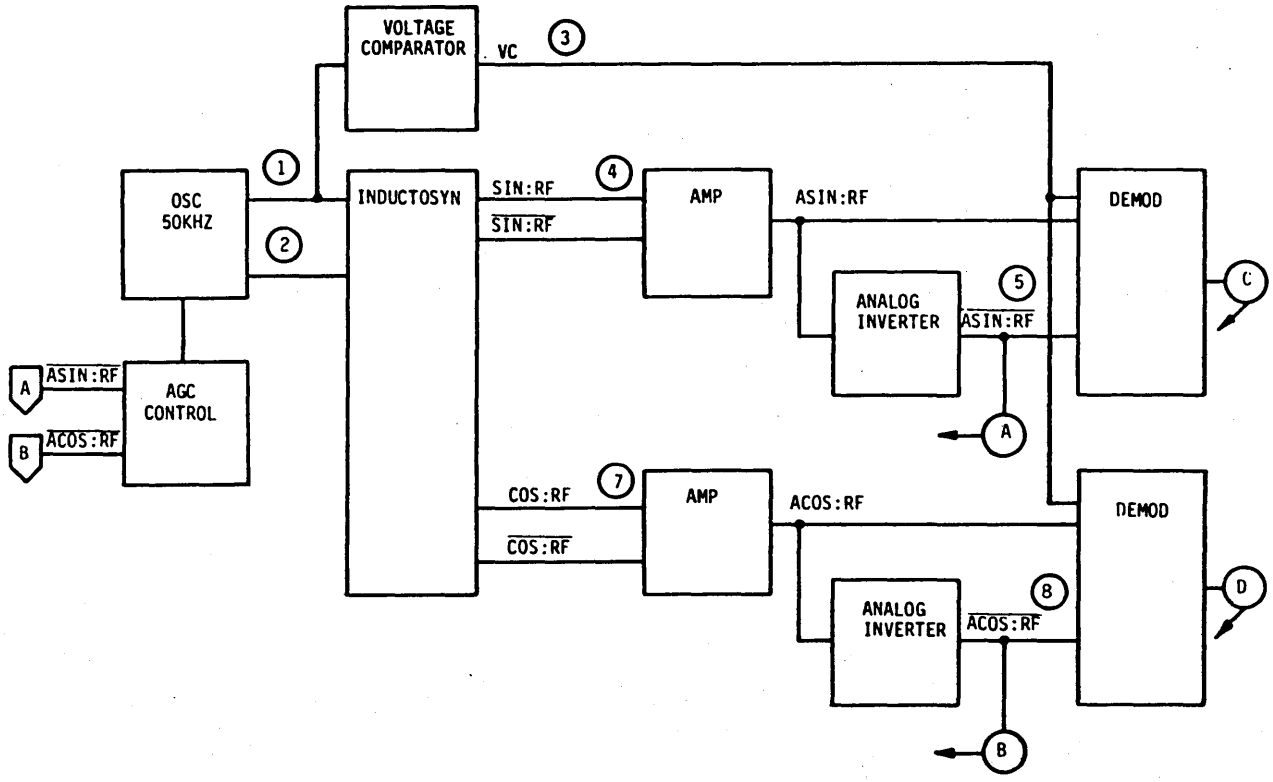
# PRIMARY/MOTOR POWER DISTRIBUTION

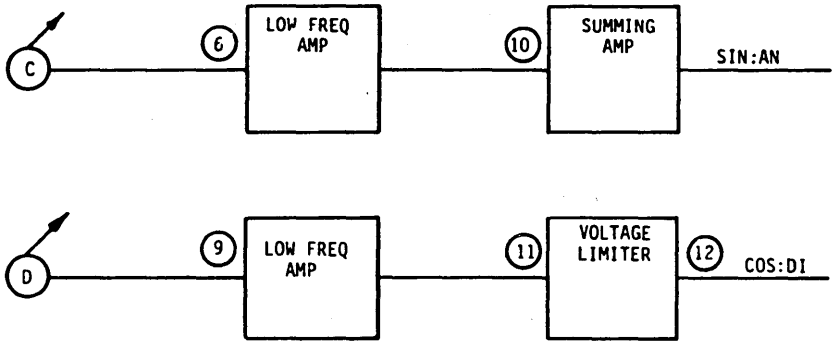


# DC-HANDLING

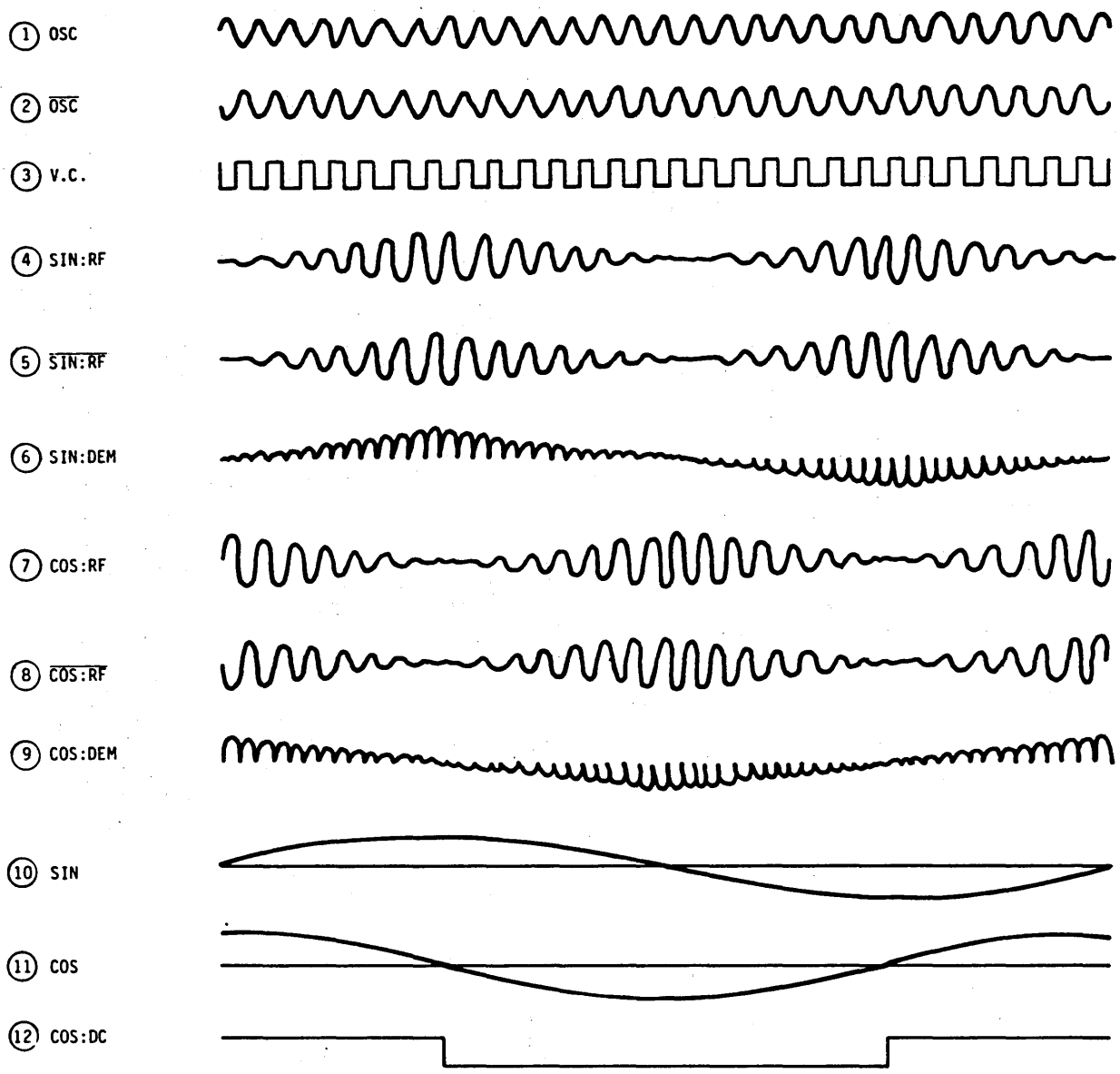

BRUSH MOTOR
M
POWER BOARD #1
POWER BOARD #2
POWER SUPPLY CHASSIS
20VAC
BRUSH
+35VDC
+22VDC
+22VDC
-35VDC
-22VDC
-22VDC
-7.5VDC
+5V
+5VDC
+11VDC
SERVO PREAMP
+22
-22
+5
+12
-12
+5
SERVO BOARD
+15
-15
R/W/Z BOARD
-5
DATA RECOVERY
-7.5
CONTROL BOARD
I/O BOARD
FAULT BOARD
SECTOR BOARD
+15
+5V
TO TRANS-DUCERS
OPERATOR PANEL

# SIN & COS GENERATION

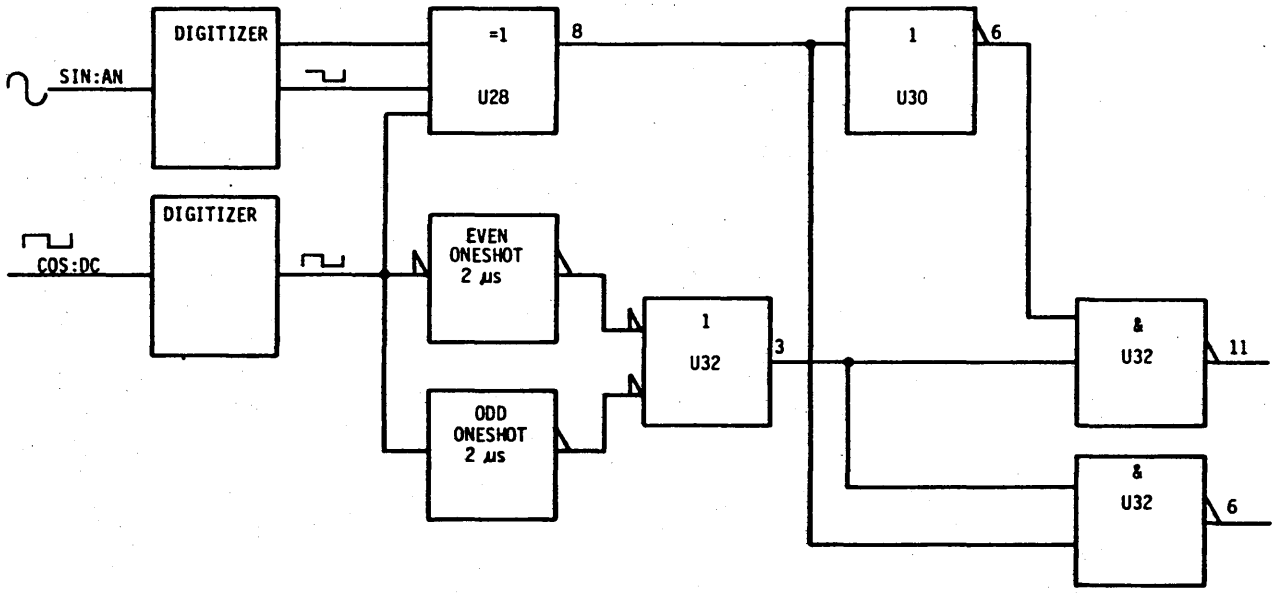



ALL LOGIC LOCATED ON THE AGC SERVO PREAMP BOARD

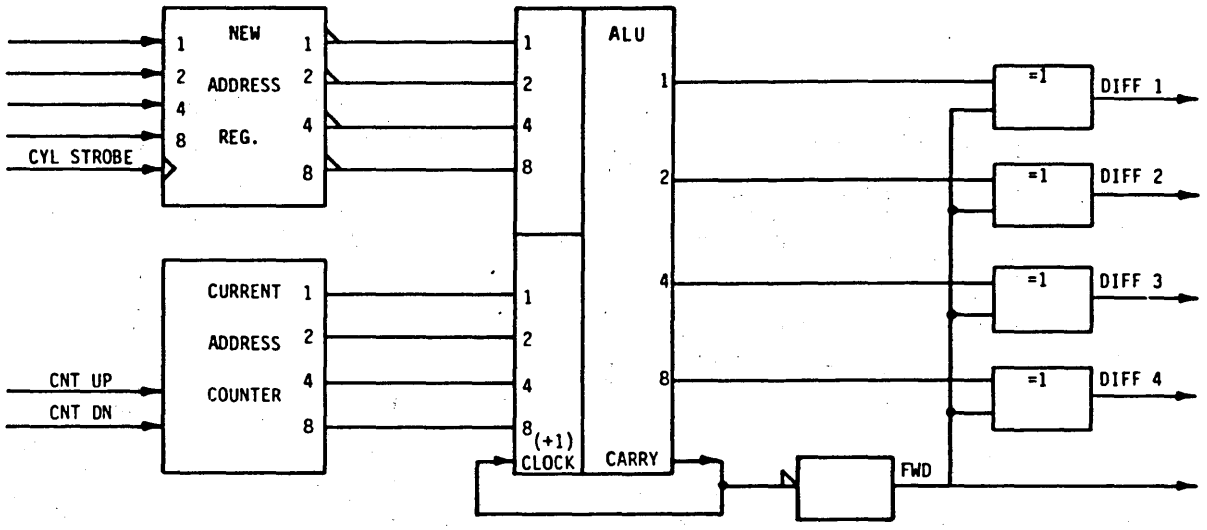



TIMING DIAGRAM

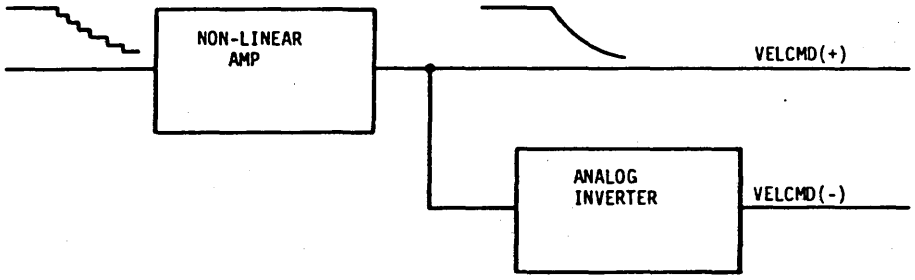



COUNT PULSE GENERATION

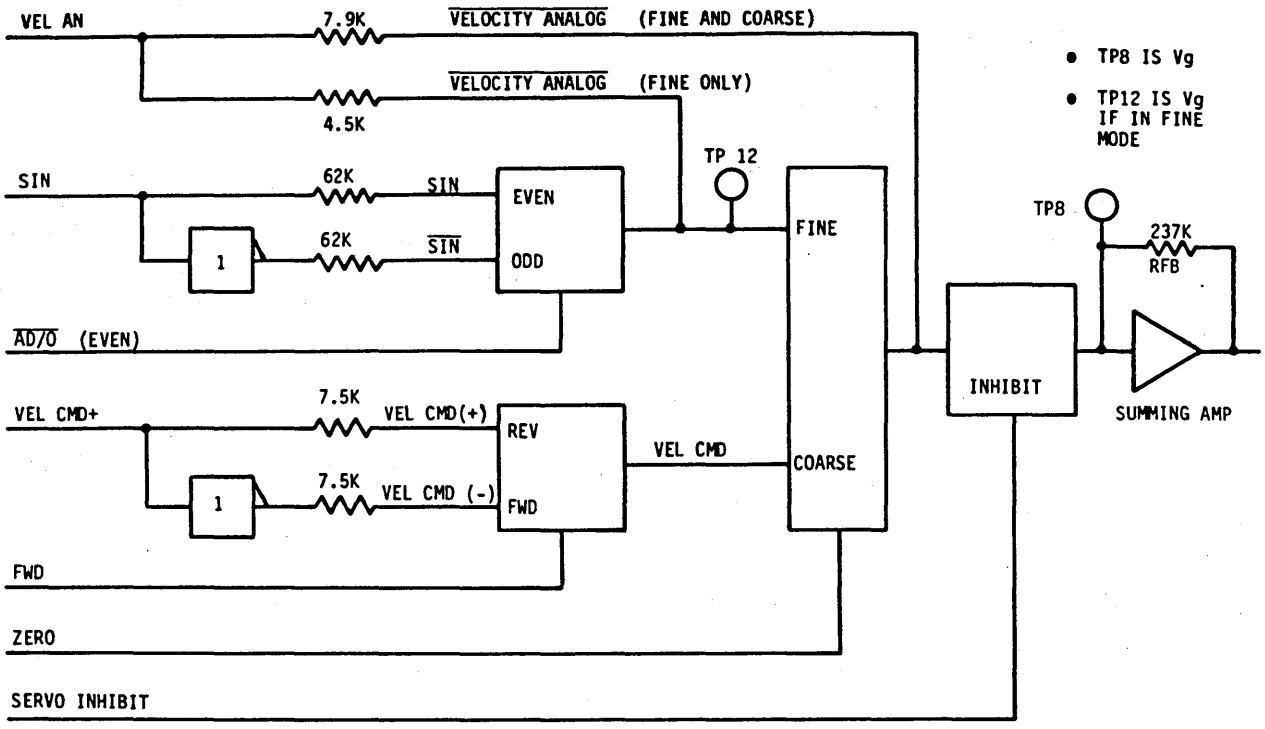
# SIMPLIFIED CYLINDER ADDRESS DIFFERENCE GENERATOR

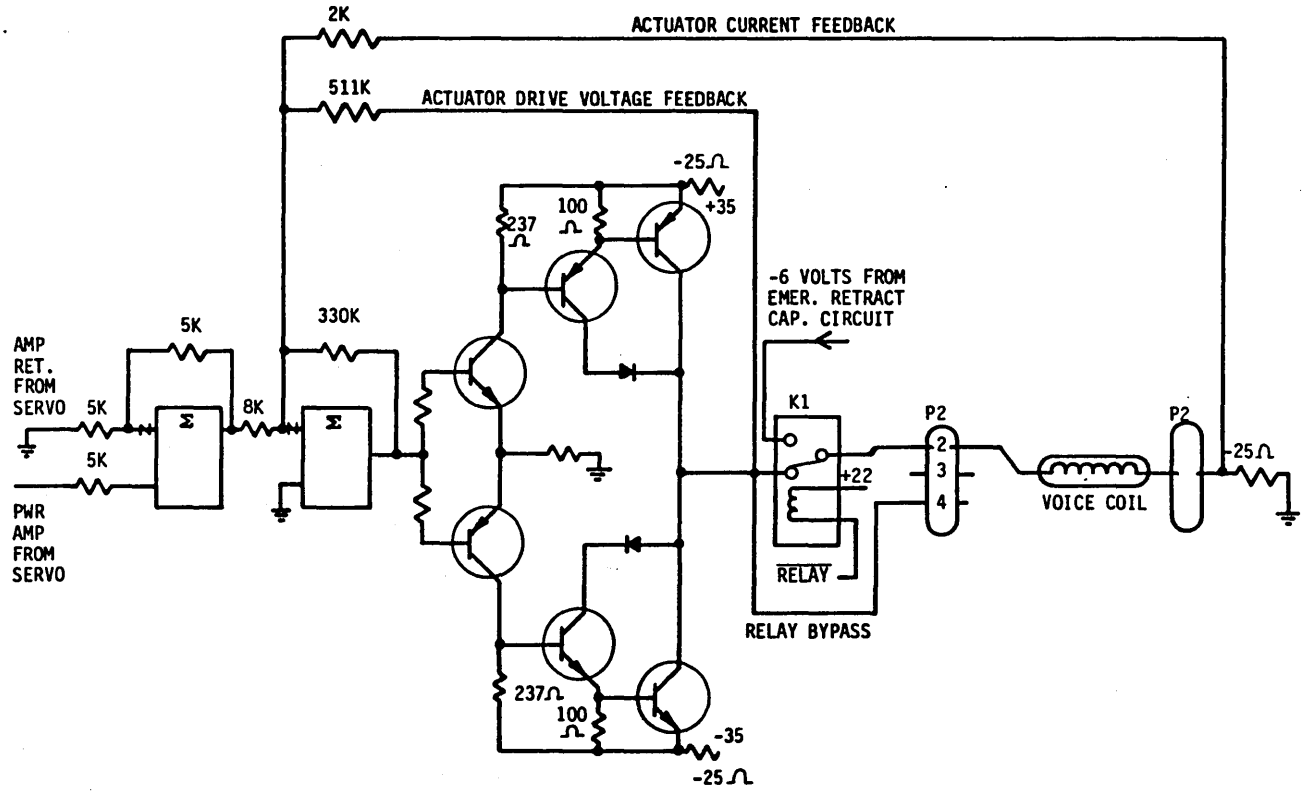


# ANALOG AMP AND INVERTER

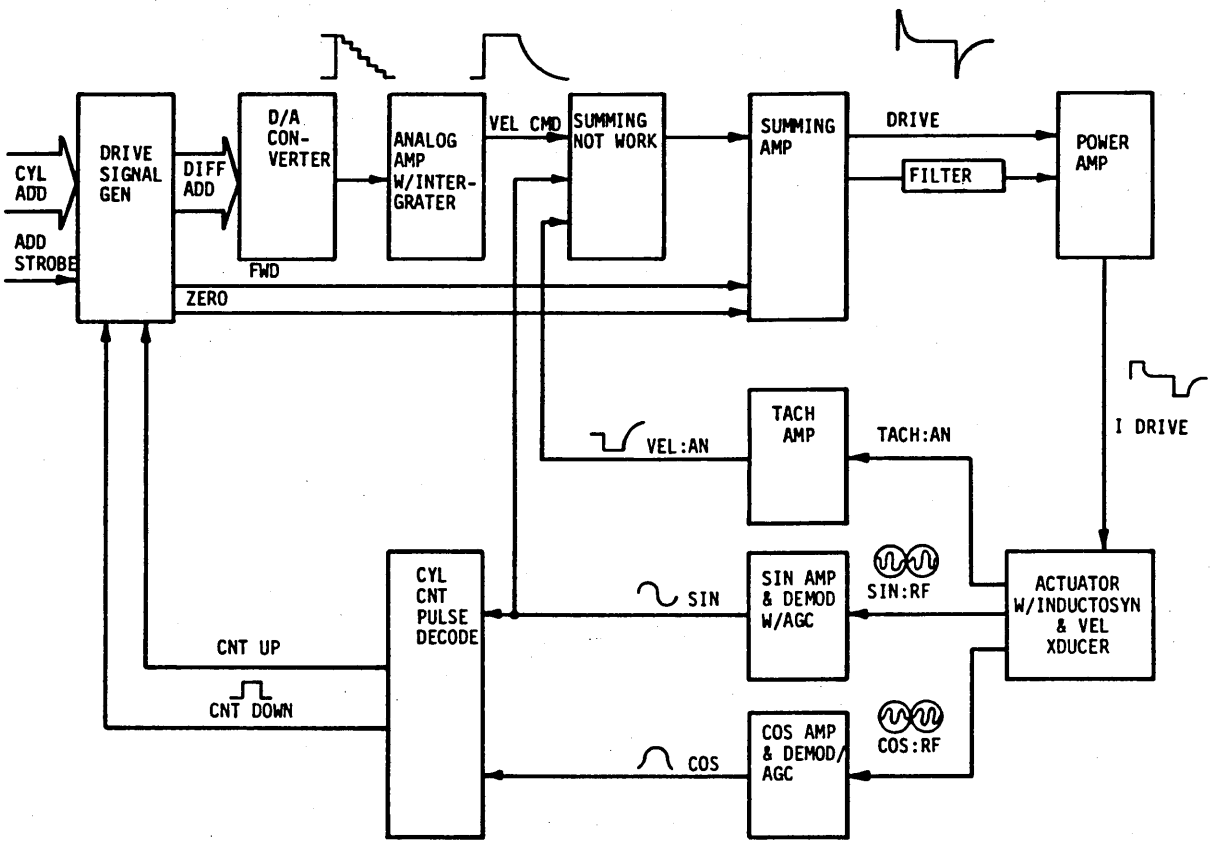


# SUMMING AMPLIFIER



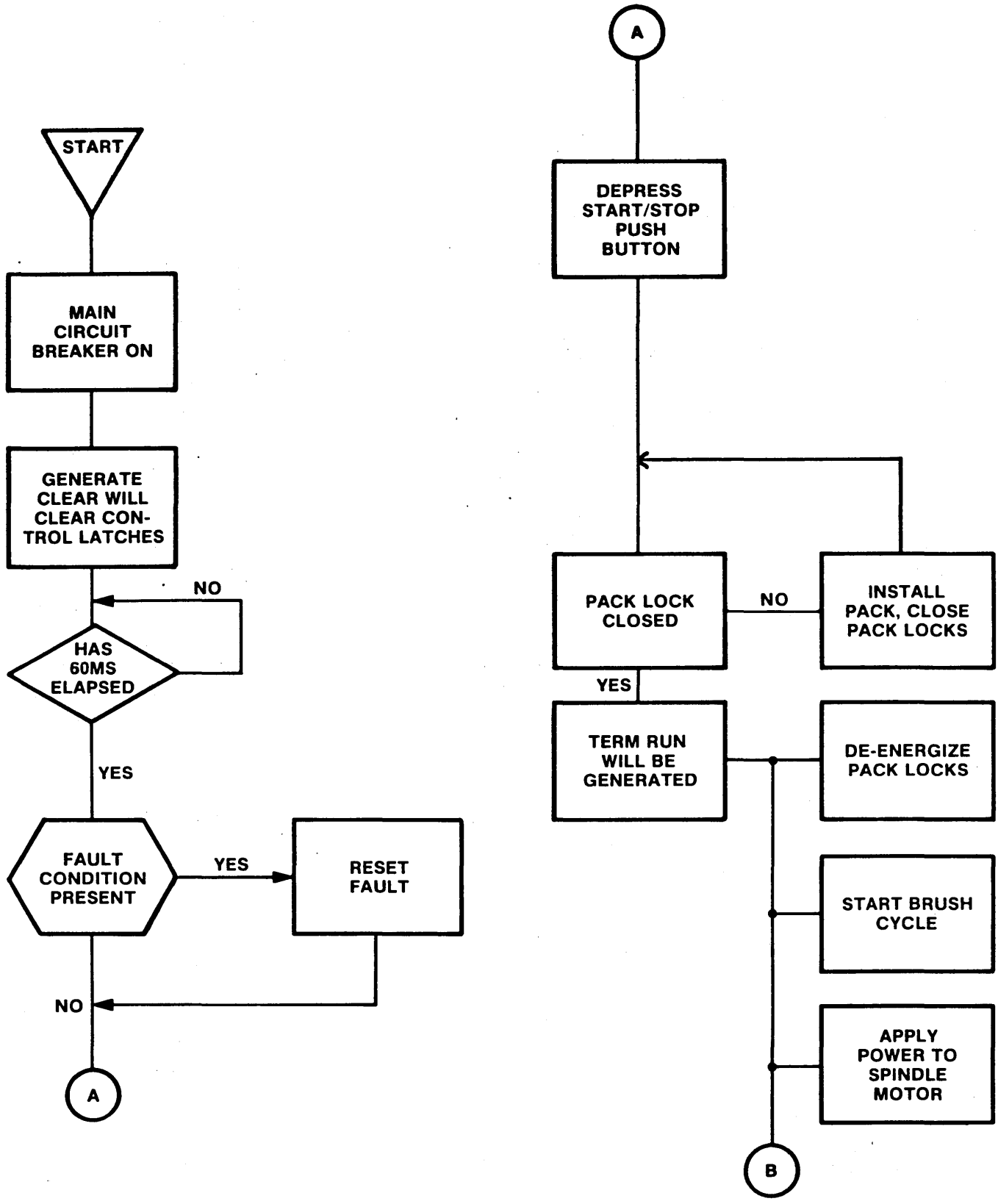


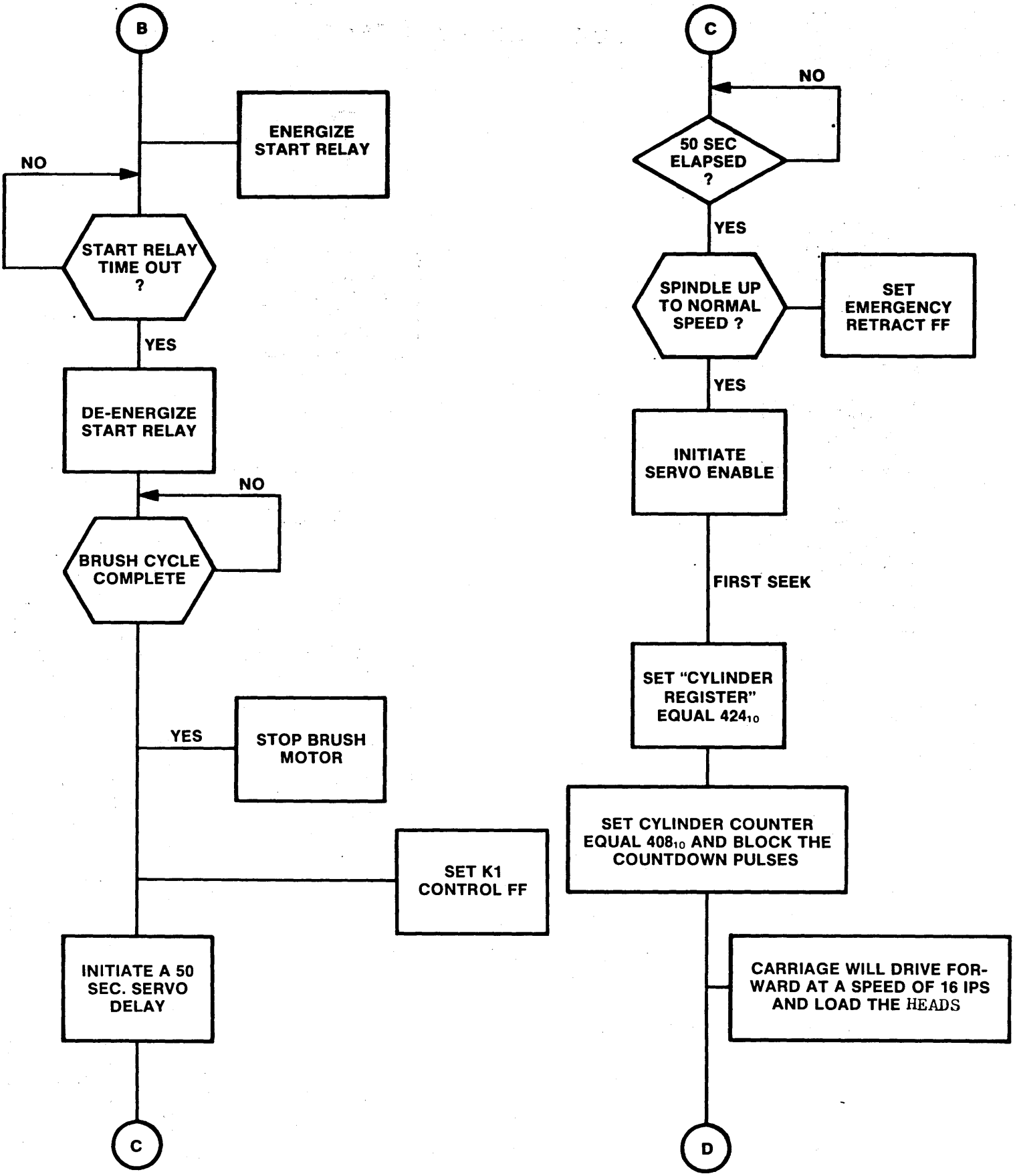

POWER AMPLIFIER

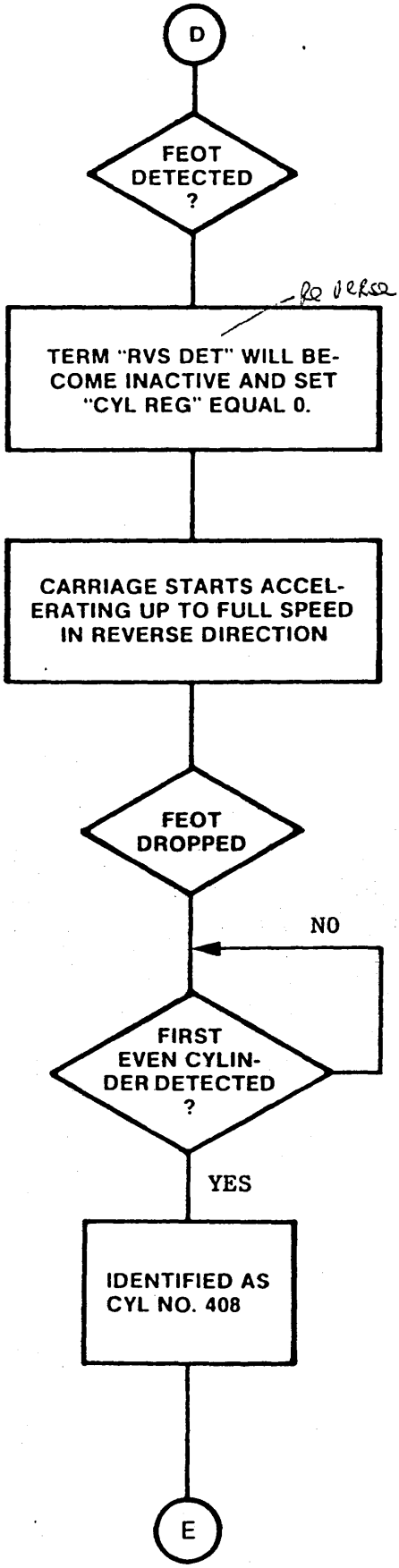


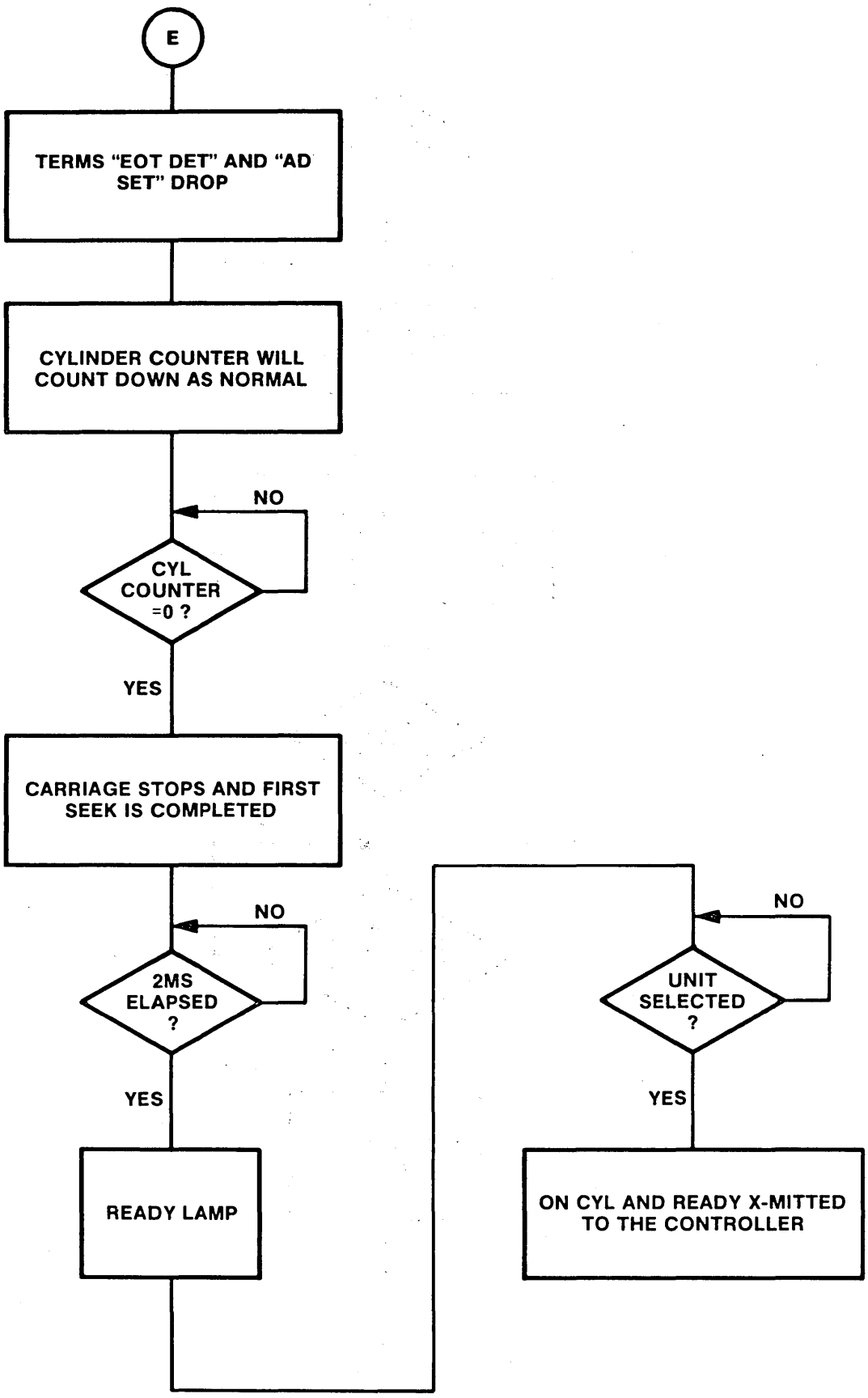

9427H SERVO SYSTEM BLOCK DIAGRAM

# POWER UP—FIRST SEEK

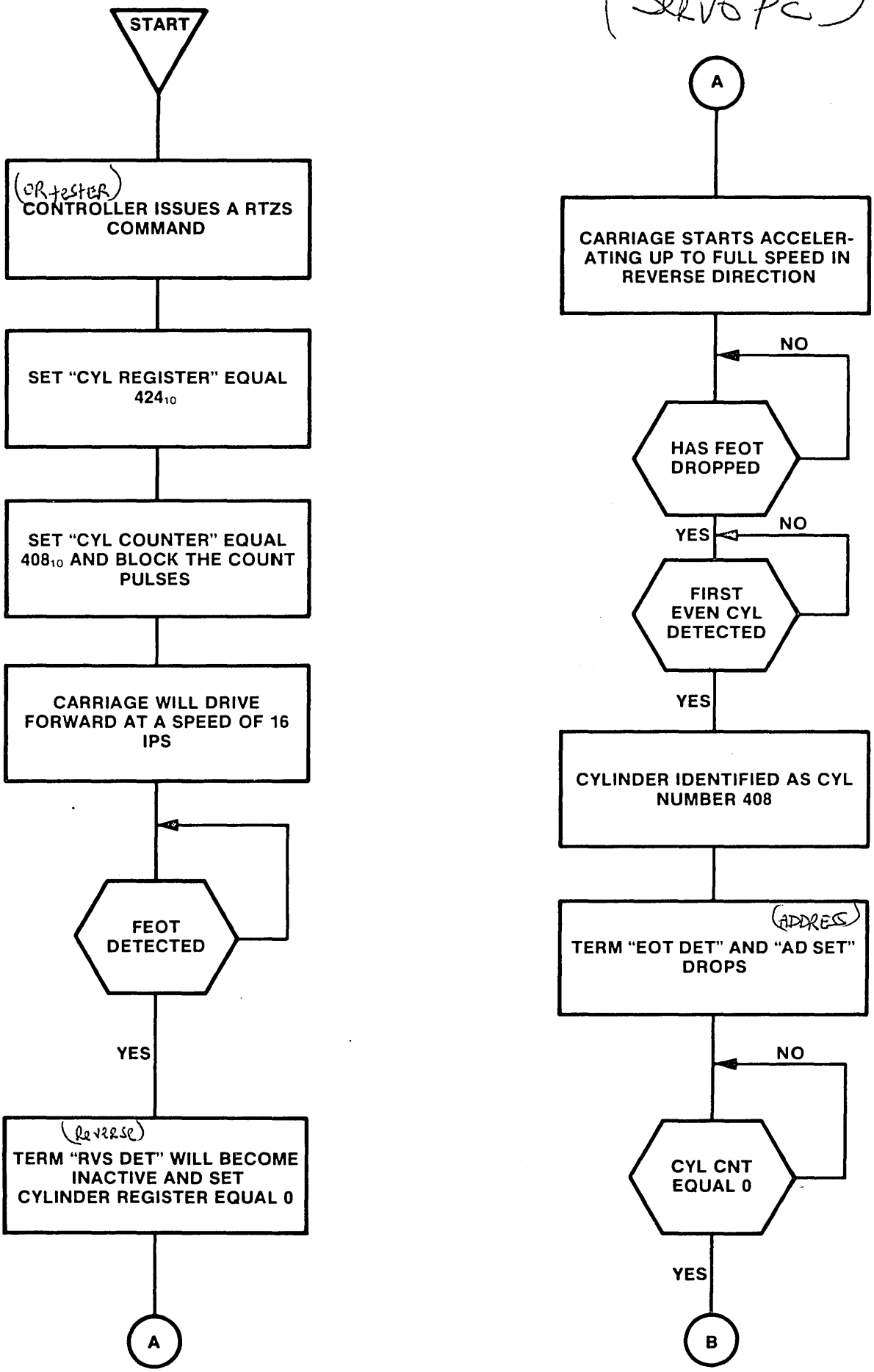


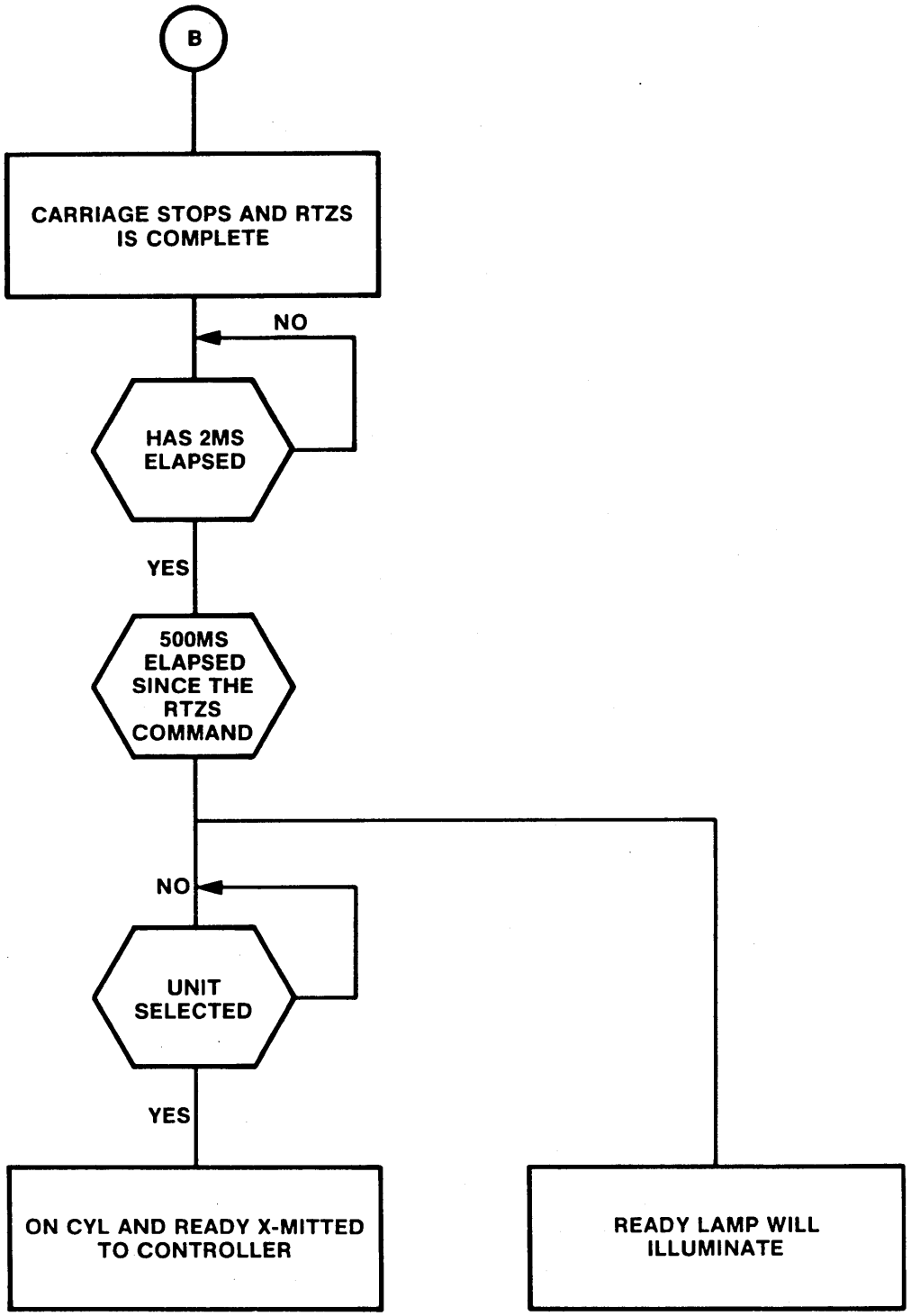

B
ENERGIZE START RELAY
NO
START RELAY TIME OUT ?
YES
DE-ENERGIZE START RELAY
NO
BRUSH CYCLE COMPLETE
YES
STOP BRUSH MOTOR
SET K1 CONTROL FF
INITIATE A 50 SEC. SERVO DELAY
C
C
NO
50 SEC ELAPSED ?
YES
SPINDLE UP TO NORMAL SPEED ?
SET EMERGENCY RETRACT FF
YES
INITIATE SERVO ENABLE
FIRST SEEK
SET "CYLINDER REGISTER" EQUAL 424₁₀
SET CYLINDER COUNTER EQUAL 408₁₀ AND BLOCK THE COUNTDOWN PULSES
CARRIAGE WILL DRIVE FORWARD AT A SPEED OF 16 IPS AND LOAD THE HEADS
D


D
FEOT DETECTED ?
TERM "RVS DET" WILL BE-COME INACTIVE AND SET "CYL REG" EQUAL 0.
CARRIAGE STARTS ACCEL-ERATING UP TO FULL SPEED IN REVERSE DIRECTION
FEOT DROPPED
NO
FIRST EVEN CYLIN-DER DETECTED ?
YES
IDENTIFIED AS CYL NO. 408
E

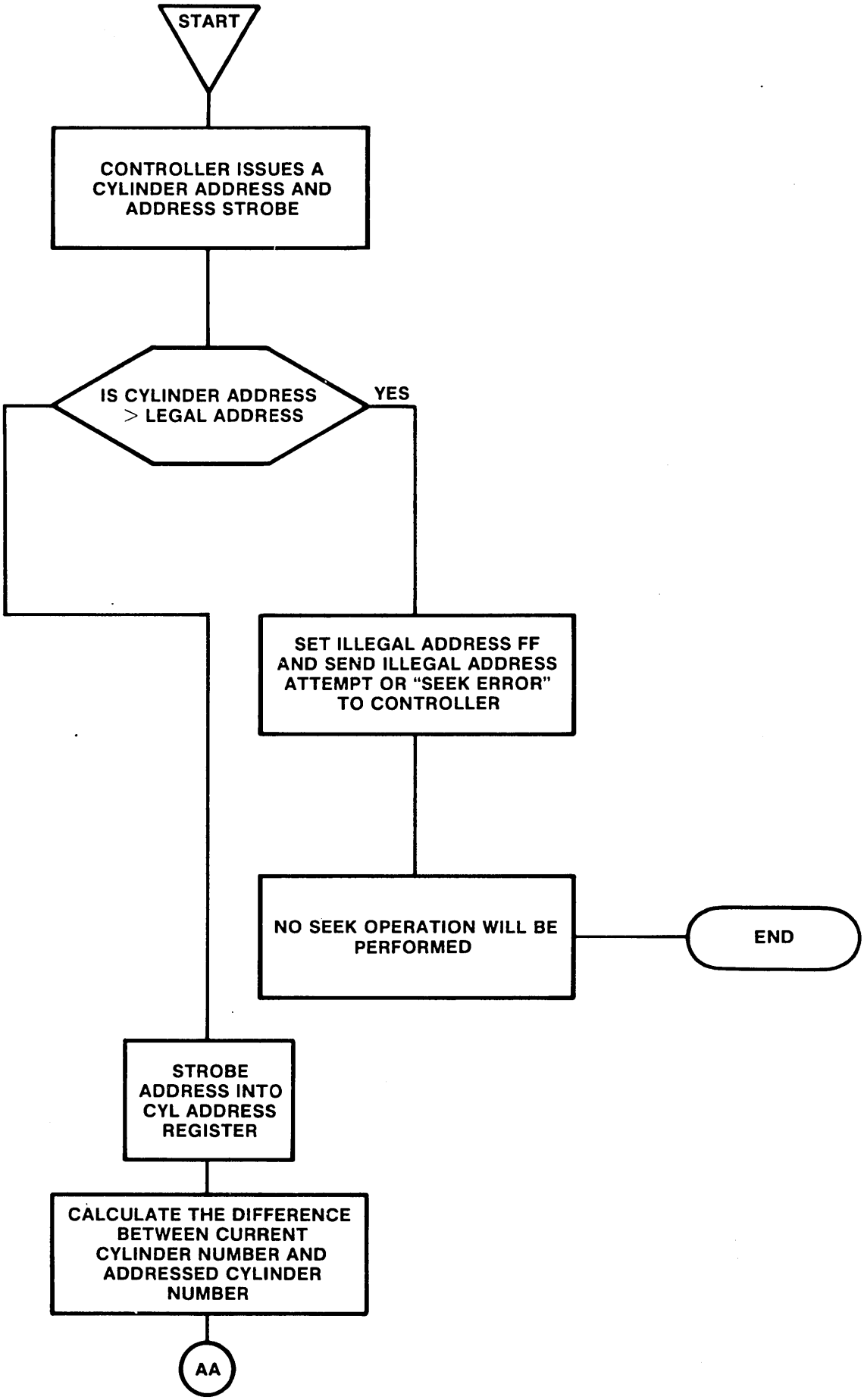

E
TERMS "EOT DET" AND "AD SET" DROP
CYLINDER COUNTER WILL COUNT DOWN AS NORMAL
NO
CYL COUNTER =0 ?
YES
CARRIAGE STOPS AND FIRST SEEK IS COMPLETED
NO
2MS ELAPSED ?
YES
READY LAMP
NO
UNIT SELECTED ?
YES
ON CYL AND READY X-MITTED TO THE CONTROLLER

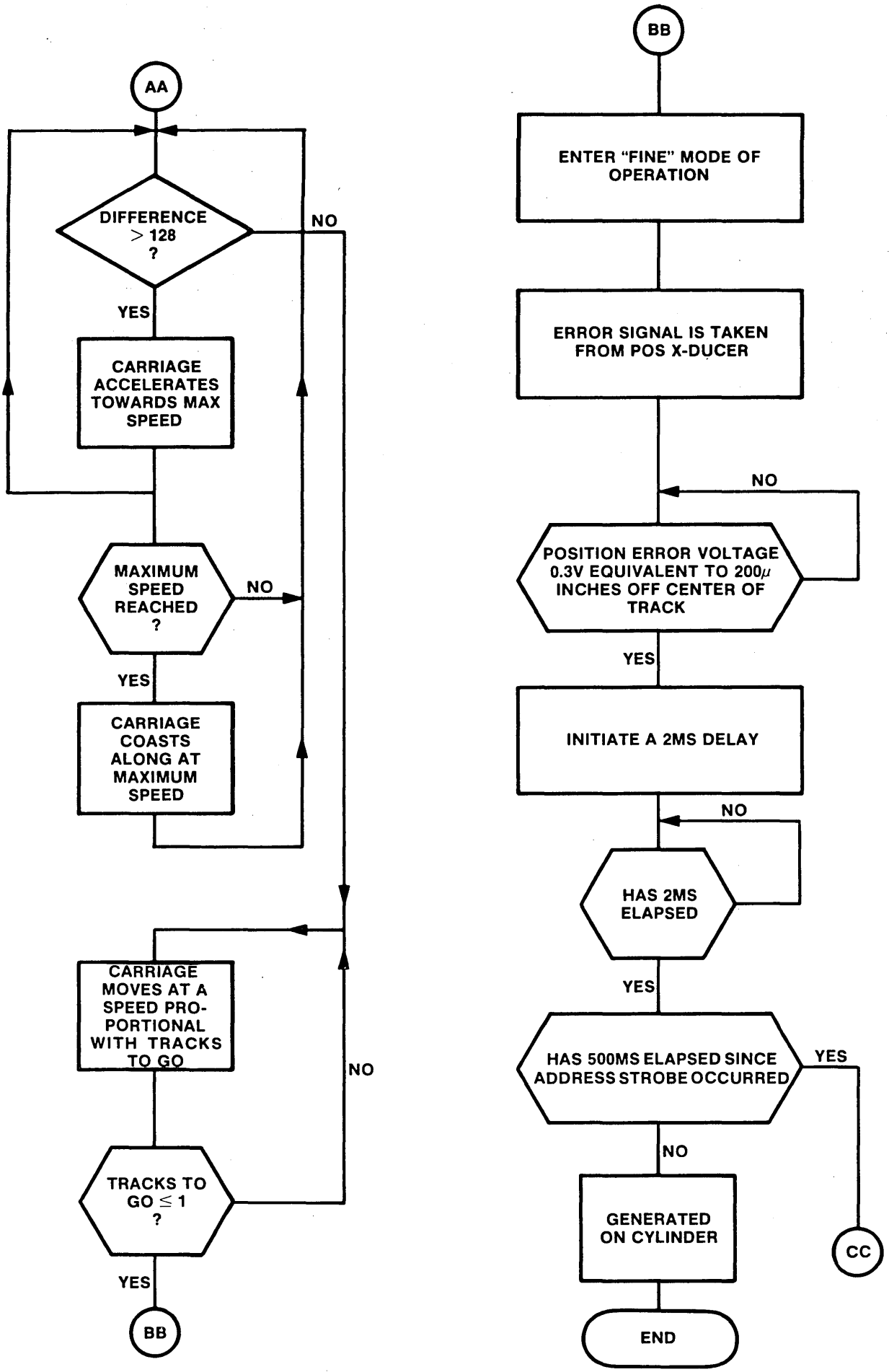
# RETURN TO ZERO SEEK (most on Servo Pc)

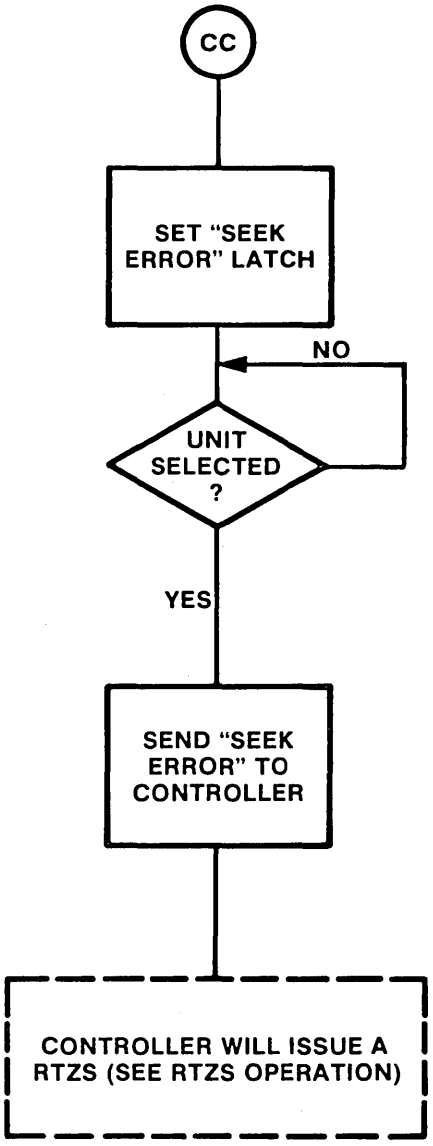

START
(OR tester) CONTROLLER ISSUES A RTZS COMMAND
SET "CYL REGISTER" EQUAL $424_{10}$
SET "CYL COUNTER" EQUAL $408_{10}$ AND BLOCK THE COUNT PULSES
CARRIAGE WILL DRIVE FORWARD AT A SPEED OF 16 IPS
FEOT DETECTED
YES
(reverse) TERM "RVS DET" WILL BECOME INACTIVE AND SET CYLINDER REGISTER EQUAL 0
A
A
CARRIAGE STARTS ACCELERATING UP TO FULL SPEED IN REVERSE DIRECTION
NO
HAS FEOT DROPPED
YES
NO
FIRST EVEN CYL DETECTED
YES
CYLINDER IDENTIFIED AS CYL NUMBER 408
(ADDRESS) TERM "EOT DET" AND "AD SET" DROPS
NO
CYL CNT EQUAL 0
YES
B

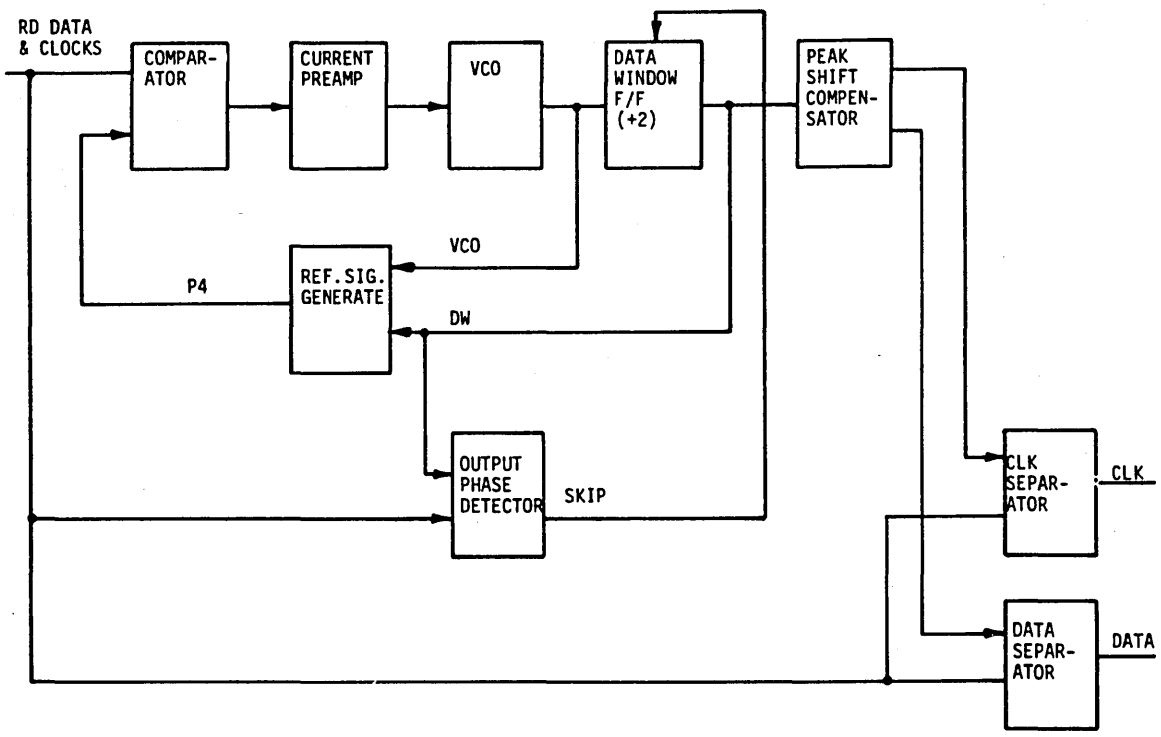

B
CARRIAGE STOPS AND RTZS IS COMPLETE
NO
HAS 2MS ELAPSED
YES
500MS ELAPSED SINCE THE RTZS COMMAND
NO
UNIT SELECTED
YES
ON CYL AND READY X-MITTED TO CONTROLLER
READY LAMP WILL ILLUMINATE

# OPERATIONAL SEEK

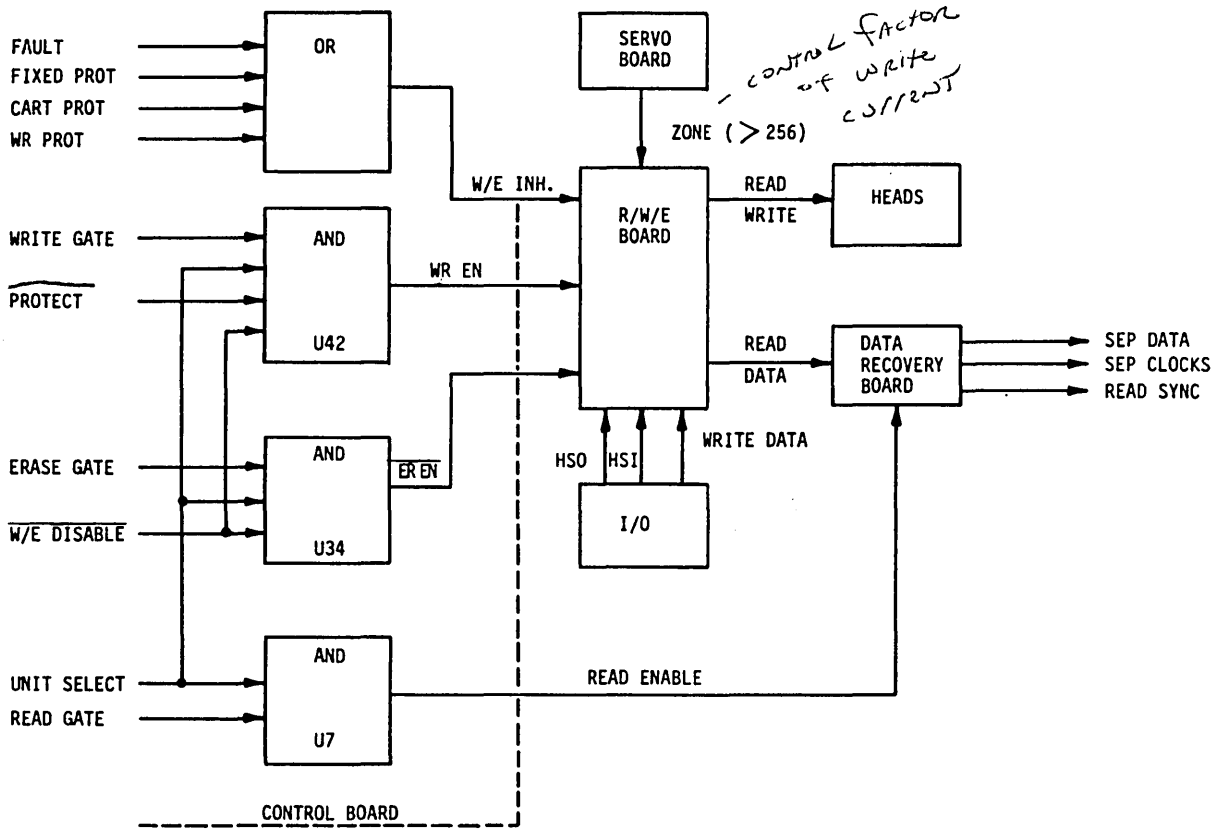

START
CONTROLLER ISSUES A CYLINDER ADDRESS AND ADDRESS STROBE
IS CYLINDER ADDRESS > LEGAL ADDRESS
YES
SET ILLEGAL ADDRESS FF AND SEND ILLEGAL ADDRESS ATTEMPT OR "SEEK ERROR" TO CONTROLLER
NO SEEK OPERATION WILL BE PERFORMED
END
STROBE ADDRESS INTO CYL ADDRESS REGISTER
CALCULATE THE DIFFERENCE BETWEEN CURRENT CYLINDER NUMBER AND ADDRESSED CYLINDER NUMBER
AA


AA
DIFFERENCE > 128 ?
NO
YES
CARRIAGE ACCELERATES TOWARDS MAX SPEED
MAXIMUM SPEED REACHED ?
NO
YES
CARRIAGE COASTS ALONG AT MAXIMUM SPEED
CARRIAGE MOVES AT A SPEED PRO-PORTIONAL WITH TRACKS TO GO
NO
TRACKS TO GO ≤ 1 ?
YES
BB
BB
ENTER "FINE" MODE OF OPERATION
ERROR SIGNAL IS TAKEN FROM POS X-DUCER
NO
POSITION ERROR VOLTAGE 0.3V EQUIVALENT TO 200μ INCHES OFF CENTER OF TRACK
YES
INITIATE A 2MS DELAY
NO
HAS 2MS ELAPSED
YES
HAS 500MS ELAPSED SINCE ADDRESS STROBE OCCURRED
YES
NO
GENERATED ON CYLINDER
CC
END

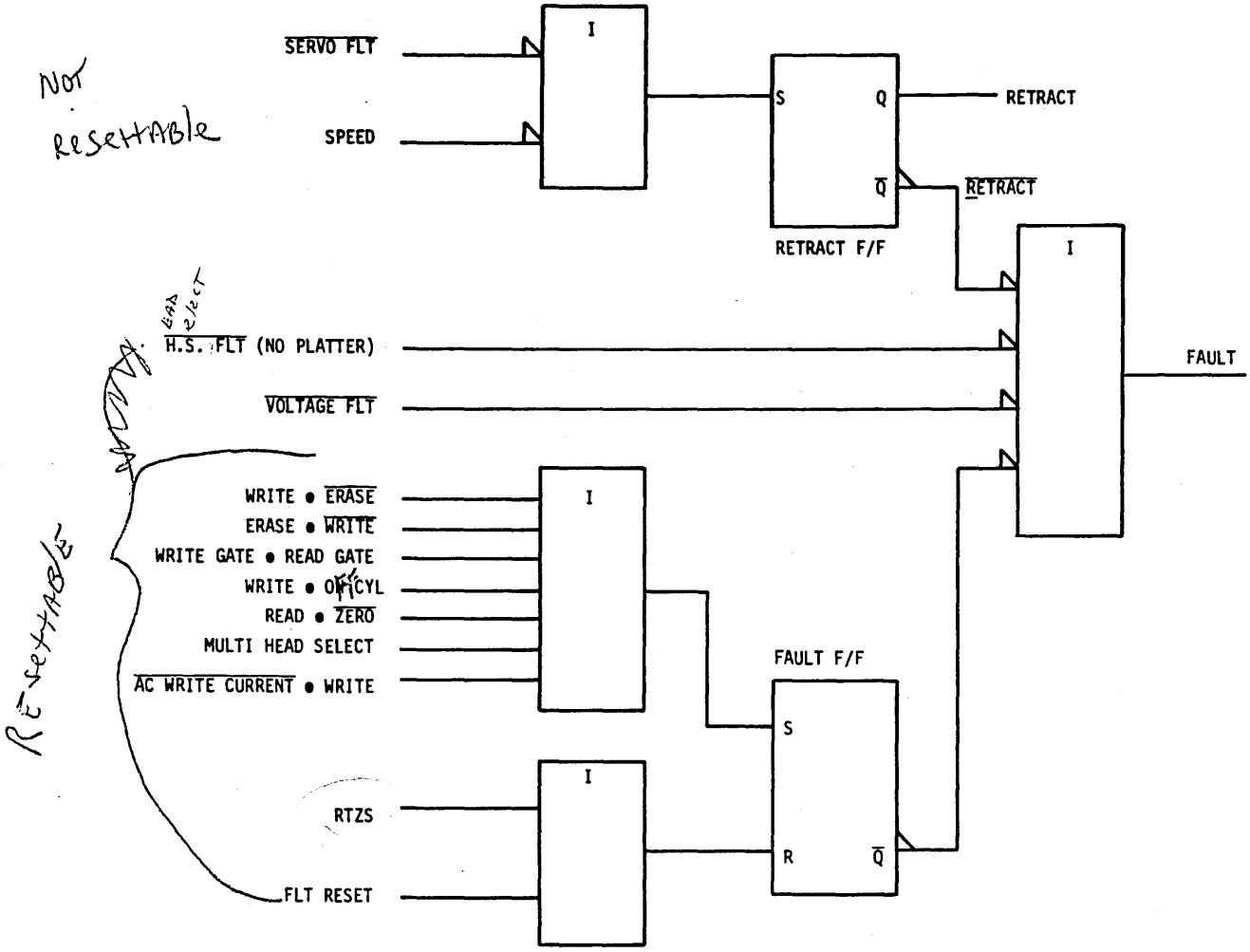

CC
SET "SEEK ERROR" LATCH
NO
UNIT SELECTED ?
YES
SEND "SEEK ERROR" TO CONTROLLER
CONTROLLER WILL ISSUE A RTZS (SEE RTZS OPERATION)




DIGITAL PHASE LOCK LOOP SEPARATOR




R/W/E/ OPERATION




FAULT LOGIC

to clear FAULT, Reset OR RTZS

| | |
|---|---|
| Active Ind. | Active Indicator - True whenever read or write is active. One shot provides longer signal, so that active lamp will light. |
| AD Ack | Address acknowledge - Interface line originating on the servo board indicating a legal address has been received. |
| AD INT | Address Interlock - Interface line originating on the servo board indicates an illegal address has been received. |
| BSNC | Brush switch normally closed. |
| BSNO | Brush switch normally open. |
| Cart. Prot. | Cartridge Protect - From switch on front panel provides write protect for cartridge disk only. |
| CD Pwr. | Voltage line to cartridge sector transducer. |
| CD Ret. | Cartridge disk sector transducer ground return line. |
| CD Sig. | Cartridge disk sector transducer output. |
| Clear | Clear is enabled upon power up. |
| Cos. DI | Cosine Digital - Output from Inductosyn cosine amplifier used to update cylinder counter on servo board. |
| CR. Flt. | Current Fault - Initially generated on read/write board. Will be true if more than one head is selected or write current without erase current, or erase current without write current, or excessive current leakage on the write driver output line during a read. |
| CT/0-3 | Center Tap Head 0-3 lines select head 0-3 for read or write operation. |
| Cyl AD/0-8 | Cylinder address line 0 through 8. The demanded cylinder or track address is sent from the controller to the drive via these lines. Normally, line 0 is the least significant bit, however, if switch 2 is used rather than switch 1, line 0 is the most significant bit. |
| Cyl. Inh. | Cylinder Inhibit - True when off track more than 200 MVolts. Disabled during search. |
| Density | The density switch SW 1-6 closed and unit select will indicate 100 TPI, unit switch off indicates 200 TPI. |
| Diff. Zero | Difference = Zero. The present address counter output is equal to the demanded address register. |

ER/0-3 — Selects the erase heads to be used during a write operation.

Erase Gate — Enables the erase current during a write operation.

Fault — Fault - Interface signal from fault gate ended with select on control BCBA. Fault = FLT Set + volt. FLT + H.S. FLT and Retract.

Fault Ind. — Fault Indicator - To fault indicator driver indicating any fault condition.

FD Pwr. — Voltage line to fixed disk sector transducer same as CD power.

FD Ret. — Fixed disk transducer ground return.

FD Sig. — Fixed disk sector transducer output.

FEOT DI — Forward End of Travel Digital - Optical sensor output is amplified and digitized on Inductosyn preamp and sent to the servo board. Used for registration on initial seek and when RTZ is required.

Fixed Prot. — Fixed Disk Protect - From switch on front panel provides write protect for fixed disk only.

Flt. Set — Fault Set - True for any current fault, read and not on cylinder, write and not on cylinder, write and read at same time.

HS/1 — Head select 1 - Selects head for fixed disk. True selects bottom head.

| H/S1 | H/SO | HD Selected |
|---|---|---|
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 2 |
| 1 | 1 | 3 |

Index — The selected index pulse out of either fixed or cartridge disk.

Interrupt — Interrupt - Interface signal to controller originating on the control board, to provide interrupt when seek is complete. SW 1-3 closed for active low interrupt. SW 1-4 closed for active high interrupt.

Inv. AD — Invalid Address - Cylinder address received is larger than highest legal address permitted.

KI RLY — KI Relay is the running relay for the spindle motor.

| | |
|---|---|
| Lock Rly. | Drive signal from lock circuitry on control board to lock relay. |
| Lock Sw. | Lock Switch - When true the lock switches are closed on the cartridge disk pack. |
| Offset. | Offset - Switch is selected from write protect interface. Will allow ±1/2 track offset via search. |
| On Cyl. | On Cylinder - Generated approximately 2 ms after the head has settled within 200 u inches of the selected track center. If position moves off at any time more than 200 u inches. On Cylinder will go false. On Cyl goes false for 10 ms with seek to same Cyl. (Strobe sign. drops on Cyl.) |
| Pwr. Amp | Power amplifier output to voice coil. Signal that drives carriage in and out. |
| RD EN | Read Enable - Generated on control board RD Gate Sel enable read logic. |
| Read Gate | Enables read data and clock information during a read operation. |
| Ready | Ready is present if the disk cartridge is installed, spindle motor in speed, heads loaded, DC voltage within margin, no fault conditions exist, unit selected and terminator is present and has power. |
| Ready Ind. | Ready Indicator - Will turn on driver for ready lamp on front panel. |
| Ready Inhibit | Ready Inhibit - Produced by any fault and SW 1-7 being closed. |
| REOT DI | Reverse End of Travel Digital - Amplified and digitized output from optical sensor on carriage assembly and actuator frame which senses the reverse end of travel. From Inductosyn preamp to servo board. |
| Rev. Stop | Reverse Stop - Retract switch closes when carriage assembly is completely retracted. |
| RWA/0-3 | Read/Write A side 0-3. Once the 0 center tap is enabled on one head, the A side of the head winding can be used to read or write data. |
| RWB/03 | Read/Write B side 0-3. Once the center tap is enabled on one head, the B side of the head winding can be used to read or write data. |
| R/W Monitor + | Read/Write Board power supply monitor - Fault detector monitors +15vDC used on R/W board via this line. |

| | |
|---|---|
| R/W Monitor - | Read/Write Board power supply monitor - Fault detector monitors -15vDC used on R/W board via this line. |
| SA/0 - SA/6 | Sector address line 0 through 6 carry the present address of the present sector, is up counted at each sector pulse. Goes to interface and out to controller. |
| Search | Search - Control board enables OSC on read/write board to provide offset of up to $\pm$1/2 track. |
| Sector | Selected sector pulse - generated by either FD or CD. |
| Seek Error | Did not go on Cyl 200 ms after seek commanded. |
| Select | Combined signal of unit select and terminator power. |
| Servo En. | Servo Enable - Is enabled 50 seconds after brush cycle complete to initiate the loading of the heads and first seek. Remains true during normal operations. |
| Servo FLT | Servo Fault - If servo board voltage goes out of limit, a fault condition is made. True for servo mon. +, servo mon. -, pre mon. +, pre mon. -. |
| Servo Mon. + | Servo power supply monitor. Fault detector monitors +15vDC used on servo board via this line. |
| Servo Mon. - | Servo power supply monitor. Fault detector monitors -15vDC used on servo board via this line. |
| Sin. AN | Sine Analog - Output from Inductosyn amplifier on inductosyn preamp. One half cycle per track to servo board. |
| SPD. Ref. | Disk speed reference generated from fixed disk index pulses. |
| Speed | Indicates that disk speed is in excess of 1000 RPM. |
| Spnd. Status | Spindle Status - Indicates if spindle is turning. Prevents the pack locks from opening while disk is turning. Start indicator on while spindle turning. |
| Start | Signal from start switch to activate spindle logic. Generated run. |
| Start Ind. | Start Indicator - Will turn on driver to lamp on front panel. Indicates spindle is turning. |
| Start Rly. | Start Relay - Will enable the start winding on the spindle motor during start-up. |
| Strobe | Used to clear search FF (U20-1) on control board when an invalid address is detected. Derivative of CYL Add Strobe. |

| | |
|---|---|
| Tach Sig. | Tachometer Signal - Output of velocity transducer, amplitude is dependent on speed of transducer which travels with carriage. |
| Termination Monitor | Power is to the terminators. |
| Unit Sel. | Unit select from controller, true will enable this disk drive. |
| Vel. AN | Velocity Analog - Output of velocity transducer is amplified on Inductosyn preamp board and sent to servo board. |
| Volt FLT | Voltage Fault. If the power supplies are outside of the voltage range, a fault will occur. True for the following P.S., R/W Mon. +, sect. mon. +, R/W mon. -, DR mon. -. |
| W/E In h. | Write/Erase Inhibit - Generated on control board when the selected disk is protected. Shuts off head select on read/write board, also generated when fault detected. |
| Wr. Enable | Write Enable - Write gate sel wrt dis wrt prot generated on control board and sent to read write board to enable write toggle F/F. |
| Write Gate | Enables write current during a write operation. |
| Write Prot. | Write Protect - Interface provides signal to prevent writing of data when true. On interface board write protect must be closed. |
| Zone | Zone - Selects one of two write current levels requires as the density increases as the lead moves toward inner tracks. When true at track 256 or greater, current is reduced. |

# 9427 HAWK
# WORKBOOK

DAY: 1

TOPIC: Publication Orientation and Component Location

OBJECTIVES: 1.0, 1.1, 1.2, 2.1, 2.2

REFERENCE MATERIAL: Hardware Maintenance Manual #77614950

ASSIGNMENT:

1. The power supply consists of two boards. Give part number and function of each board.

   a. p/s # 1 7783032 1 - p/s to Logic . +5 +22V ½ of power Amp
   b. p/s # 2 77830330 - power Amp ½ power Amp - emergency retr Brush mtr, TRIACS

2. What is the purpose of A1K1 on Power Supply board #1?

   a. Emergency RETRACT RELAY

3. There are six switches/indicator on the operator's control panel. Give the function of these switches/indicators.

   a. START STOP - ON OFF
   b. READY - DRIVE IS UP to speed
   c. ACTIVE - BUSY
   d. FAULT/REST - SOFT FAULT
   e. W Protect/CART - W Protect on the CARTRIDGE
   f. W/Protect/FIXED - " " on the fixed

4. Locate and identify the circuit boards in the logic chassis and the part number for each. Omit I/O board.

   a. CONTROL BOARD 75885452
   b. SERVO 77831401
   c. Sector 77622950
   d. READ WRITE ERASE 75891100
   e. DATA RECOVERY 75297105

5. Give location of absolute air filter and part number.

   a. UNDERDRIVE P3437400

6. To select the proper input voltage for a specific requirement the programmable plug P12 is used. Give the pins used to program the unit for 120VAC input.

   a. 14 to 2
   b. 15 to 7
   c. 11 to 12

14 & 15 ALWAYS HARDWIRED

7. There are four relays associated with the drive rotational functions. They are A7K1, A7K2, A7K3 and A1K1. Give their location, function and part number.

   a. A7K1 START WINDING } 77612677 DRIVE MOTOR ASSY.
   b. A7K2 RUN WINDING }
   c. A7K3 BRAKE - DRIVE MOTOR ASSY. 77612660
   d. A1K1 EMERGENCY RETRACT - ~~SERVO PREAMP~~ P/S #2 ~~77612660~~ 22940804

8. You're working on a drive that you suspect to have a bad AGC servo pre amp. What part number would you use to order a new board?

   a. 77658660-0

9. If drive is rack mounted the pre-filter is located inside the absolute filter. What is the pre-filter part number for a rack mount drive?

   a. 77604000

10. The Hardware Maintenance Manual #77614950 contains no logic diagram for the I/O board. Where is the logic diagram for the I/O board found? Why is it done in this manner?

    a. In the HPC
    b. Why? EACH DRIVE IS MANUFACTURED ACCORDING to the CODES-

11. Reading Assignment

    a. Read Section 4 of Hardware Maintenance Manual #77614950.

9427 HAWK
WORKBOOK

DAY: 2

TOPIC: Functional Analysis

OBJECTIVES: 3.0, 3.1, 3.3, 3.3.1, 3.5

REFERENCE MATERIAL: Hardware Maintenance Manual #77614950

ASSIGNMENT:

1. Using the power distribution block diagrams in your handout package (HO-13 and HO-14) answer the following questions.

   1) When will relay A7K1 be picked? when spindle is upto speed

      a.

   2) True or false. Relays A7K1 and A7K2 must be picked for drive motor to start.

      a. TRUE

   3) What voltage is used by the brush motor?

      a. 20V A/C

   4) Regulation of the DC power applied to the logic cards is handled at each card except for what voltage?

      a. +5V

   5) The input voltage to the power supply is selected by a programmable power plug P12. What are the pin assignments of jumper #1, 2 and 3 if 160volts is used as the power source?

      a. Jumper #1 14 4
      b. Jumper #2 15 5
      c. Jumper #3 14 15

2. Using the servo system block diagram in your handout package (HO-21) answer the following questions.

   1) What is the function of the drive signal generator?

      a. COUNTER

   2) If there is a carry bit generated in the ALU the drive will seek in what direction?

      a. FORWARD

3) The D/A converter output will step down in proportion to the number of tracks to go when the difference count is less than .

4) Where is the power amplifier located?

a. On the power Amplifier Board on the P/S

5) What signals are summed together in the course mode of operation?

a. FWD AND REV

6) What does the term "ZERO" initiate? MAKES the switch from
a. COARSE to fine modes.

3. What function does the input signal "STOP OVERRIDE" perform?

a. DISABLES the stop signal from the front panel until unit selection stops.

4. Reading Assignment

a. Read over check and adjustments in Section 6 of Hardware Maintenance Manual 77614950.

# SAFETY PRACTICES

All engineers are expected to follow reasonable and appropriate precautions with respect to electrical, mechanical, and personal safety hazards while working on computer system equipment. You should pay careful attention to all entries in the maintenance documentation labeled "*DANGER*" or "*WARNING*", which identify hazardous areas or procedures encountered in maintaining the system equipment. The following additional procedures should be followed when working on equipment:

## PERSONAL

1. You are responsible for insuring that no action on your part causes unsafe conditions that may expose customer personnel to hazards in any device.

2. You should never work alone on equipment having exposed operating mechanical parts or exposed hazardous power components. If you MUST do so notify your EIC or manager. In any case, the following precautions must be observed:

   a. Someone familiar with the power-off controls must be in the immediate area.

   b. Personal jewelry (rings, wristwatches, bracelets, necklaces, etc.) shall be removed. A small box in the CE tool kit will make a good storage place for these items.

   c. If using one hand, keep the other one in your pocket.

   d. Avoid wearing loose articles of clothing that can be snagged and drawn into moving machinery. Wear short-sleeve shirts or roll sleeves above the elbow. Neckties, where required, should be tucked in between the second and third shirt button or fastened about 3 inches from the end with a tietack or tieclasp, preferable non-conductive. Don't use tiechains. Clipon type neckties are preferable to the regular ones; if caught they will pull free without causing injury.

   e Before starting equipment, make sure that no other CE or customer personnel are in a position where they could get hurt.

   f. While working in equipment put red tape strips across any power controls, or use "DO NOT OPERATE" tags where available.

3. Keep CE tool kits out of walkways; put them on or under a desk or table.

4. Put doors and covers removed from a machine in a safe, out-of-the-way location where nobody will trip over them or cause them to fall on top of someone. ALL machine covers MUST be restored in place before the machine is returned to the customer.

5. All safety covers, guards, shields, groundstraps, panels, etc. shall be properly reinstalled after maintenance is finished.

6. Maintain good housekeeping practices during and following each maintenance activity. Do not permit tools, manuals, wipers, paper trash and the like to accumulate in the work area, and CLEAN UP AFTER YOURSELF.

ELECTRICAL

1. Remove ALL AC and DC power when removing or installing major assemblies, working inside power supplies or power control enclosures, performing detailed mechanical maintenance procedures, or doing wiring and/or module changes in the machine. If possible, turn off and lock or tag the circuit breaker in the service panel on the wall; unplug the main power supply cord.

2. Use only well-insulated pliers, screwdrivers, test leads, etc. when working on or near live circuits.

3. Do not disconnect or otherwise disable safety grounding systems even if the equipment is powered off. These are installed for YOUR protection.

4. Avoid coming in contact with grounds, such as equipment frames, metal floor tile edgings, electrical conduits, and the like. If possible, locally purchase rubber or vinyl mats.

MECHANICAL

1. Do not use chemicals, greases, oils, or solvents that have not been specifically approved by the equipment manufacturer for that device. Their recommendations are usually based on extensive experience with his equipment in service.

2. Use the proper tools for the job. Improper use of tools can result in personal injury or equipment damage.

3. Replace worn or broken tools or test equipment as quickly as possible.

4. If the machine is running, DO NOT reach in to the works; remember, they are YOUR fingers and you only get one set per lifetime.

5. If using a strobelight on mechanical devices, DON'T TOUCH ANYTHING; it may be moving.

6. Safety glasses or goggles must be used if you are:

   a. driving pins, riveting, swaging, and similar activities.

   b. using an electric drill, grinder, reamer, etc.

   c. installing or removing springs under tension or compression.

   d. using any type of solvent, spray, or chemical for cleaning or touch-up painting.

e. any other activity which may endanger the eyes. They are YOUR eyes, and you need them for this type of work.

7. When lifting, use a method that will not injure the spine or strain back muscles. Be realistic as to what your capacity for lifting really is.

ABOVE ALL, USE GOOD JUDGEMENT AND COMMON SENSE - A MOMENT OF THOUGHT BEFORE YOU ACT CAN SAVE HOURS OF AGONIZING AFTERTHOUGHT.

# 9427 HAWK
# STUDENT LAB MANUAL

| | |
|---|---|
| DAY: | 1 |
| TOPIC: | Introductory Lab |
| OBJECTIVES: | 1.0, 1.1 |
| REFERENCE MATERIAL: | Hardware Maintenance Manual #77614950 |
| EQUIPMENT/TOOLS: | 9427H Disk Drive<br>Standard Hand Tools |

PROCEDURES:

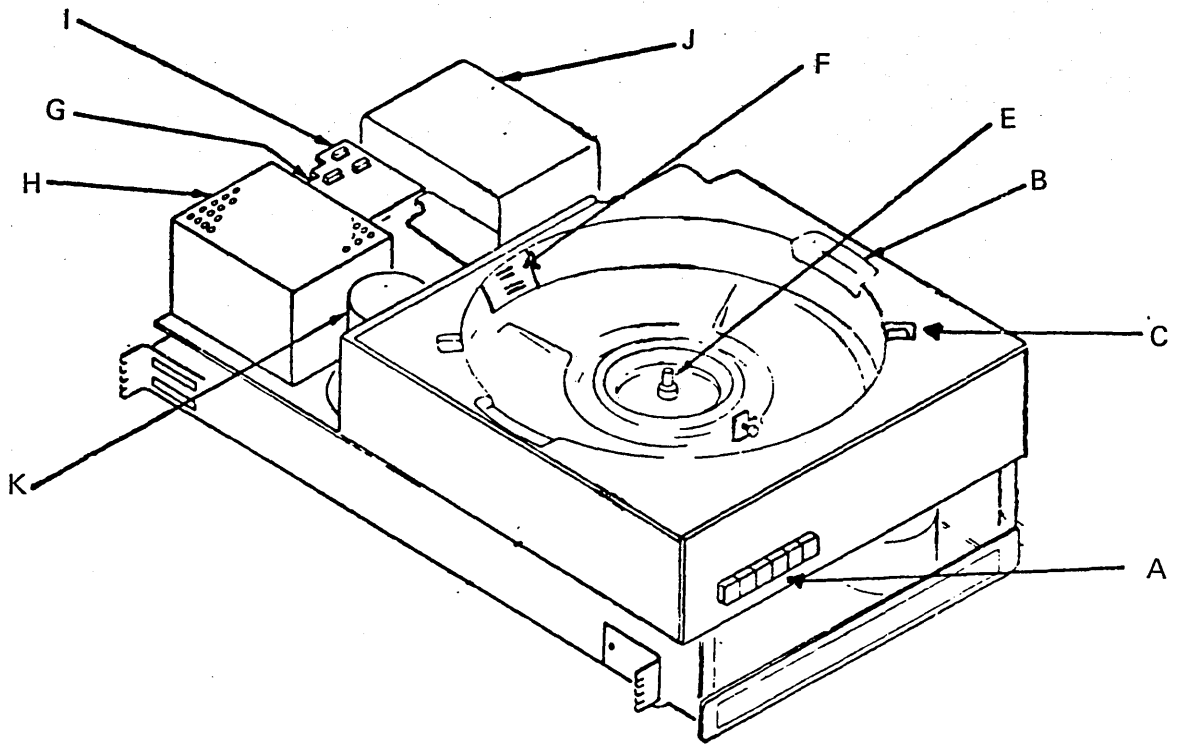
1. Using the lab sheet provided, SLM-5 and 6 identify the following lettered assemblies and match the letter to the name on the list.

2. When you have completed the lab exercise, notify the instructor. Save this lab sheet for your reference.

Instructor Checkpoint

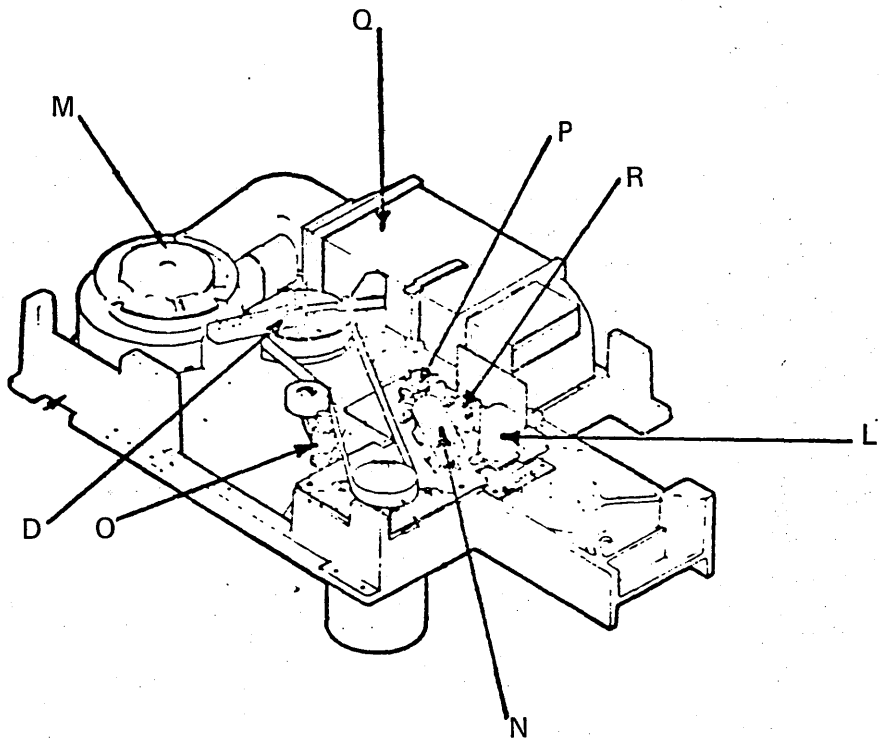
A. Identify the following lettered assemblies and match the letters to the name in the list:

1. Control Panel A
2. Cartridge Receiver B
3. Pack Locks C
4. Spindle E
5. Drive Motor K
6. Power Supply J
7. Head Assembly F
8. Servo Pre Amp I
9. Actuator/Magnet Assembly G
10. Card Cage H



A. Identify the following lettered assemblies and match the letters to the name in the list:

11. Fixed Disk Sector Assembly D
12. Drive Motor Start Capacitor N
13. Idler Assembly O
14. Brake Relay L
15. Start Relay P
16. Run Relay R
17. Blower Motor M
18. Absolute Filter Q



DAY: 3

TOPIC: Operational Lab

OBJECTIVES: 5.2

REFERENCE MATERIAL: Hardware Maintenance Manual #77614950
Field Test Unit Operating Instructions

EQUIPMENT/TOOLS: 9427H Disk Drive
Field Test Unit TB118-A
Standard Hand Tools
9427H Maintenance Tools
Scratch Disk Pack
CE Disk Pack
Oscilloscope

PROCEDURES:

1. Operating the field test unit.

   a. Connect the I/O cable from the FTU to the 9427H as shown in the operating instructions.

   NOTE

   There are two I/O cables used with this tester. One is used for a 3M connector and the other is used with the different adapters available for different type connectors.

   b. Perform step 1 of General Operating Procedures as outlined in Section 2.1.1 of FTU Operating Instructions.

   c. Turn power on to tester and perform power up procedure on drive. The power, on cylinder and ready LED's should be illuminated on FTU front panel.

   Instructor Checkpoint

d. Perform the following procedures on the disk drive using the FTU.

NOTE

Instructor assistance is available.

Procedure 1: Direct seek
Procedure 2: Alternate seek
Procedure 3: Sequential forward
Prcoedure 4: Sequential reverse
Procedure 5: Sequence direct
Procedure 6: Random direct

Instructor Checkpoint

2. Test and adjustments.

a. Remove Read/Write head number zero, in accordance with procedures in Section 6.6.2 of Hardware Maintenance Manual #77614950.

b. Inspect the head in accordance with procedure outlined in Section 6.5.2 of Hardware Maintenance Manual #77614950.

c. Replace the head in accordance with procedure outlined in Section 6.6.2 of Hardware Maintenance Manual #77614950.

d. Read/Write head alignment.

1. Connect the FTU to the 9427H disk drive and load CE pack on drive.

2. Following the procedures in Section 6.7.4 of the Hardware Maintenance Manual #77614950, perform alignment of all heads as necessary.

3. Following the procedures in Section 6.7.5 of the Hardware Maintenance manual #77614950, perform Head Skew and Index Burst Check and Adjustment

E. Perform AGC servo pre-amplifier and inductosyn check and adjustment in accordance with Section 6.7.2 of Hardware Maintenance Manual #77614950.

F. Perform FEOT check and adjustment in accordance with Section 6.7.3 of Hardware Maintenance Manual #77614950.

G. Inform Instructor when you have completed this lab exercise.

Instructor Checkpoint

DAY: 3

TOPIC: Preventive/Corrective Maintenance Lab

OBJECTIVES: 4.0, 4.1, 4.2, 4.2.1, 5.1

REFERENCE MATERIAL: Hardware Maintenance Manual #77614950

EQUIPMENT/TOOLS: 9427H Disk Drive
Standard Hand Tools
9427H Maintenance Tools

PROCEDURES:

1. Perform the level 3 preventive maintenance. Have your instructor initial each procedure as it is completed.

   Inst. Initial

   a. Disk cartridge inspection and cleaning
   b. Fixed disk inspection and cleaning
   c. Pre-filter cleaning

2. Perform the level 5 preventive maintenance. Have your instructor initial each procedure as it is completed.

   a. Absolute filter removal and replacement
   b. Disk brush - check and replacement

3. Perform the removal and replacement of the following components and have your instructor initial each step as it is completed.

   Instructor Initials

   Removal Replacement

   a. Actuator assembly
   b. Velocity transducer
   c. Cartridge disk index/sector transducer
   d. Fixed disk index/sector transducer
   e. Spindle assembly

4. Notify your instructor when you have completed this exercise.

| | |
|---|---|
| DAY: | 4 |
| TOPIC: | Maintenance Lab |
| OBJECTIVES: | 5.0, 5.1, 5.2 |
| REFERENCE MATERIAL: | Hardware Maintenance Manual #77614950<br>Field Test Unit Operating Instructions |
| EQUIPMENT/TOOLS: | 9427H Disk Drive<br>Field Test Unit TB-118A<br>Standard Hand Tools and 9427H Maintenance Tools<br>Scratch Disk Pack<br>CE Disk Pack<br>Diagnostic Disk Pack |

PROCEDURES:

1. While performing troubleshooting use the troubleshooting worksheets to record the initial indications of the fault and steps taken to correct problem.

9427 HAWK
TROUBLESHOOTING WORKSHEET
STUDENT LAB MANUAL

MALFUNCTION #

ISOLATION:

Initial Indications:

Steps used to correct problem:

When problem corrected inform instructor.

Instructor Checkpoint

# 9427 HAWK
# FINAL EXAM

When marking your answer sheet put a dark circle over the most correct answer.
Example: A ● C D

1. A train of pulses is derived from the magnetic transducer detecting notches in the cartridge hub. These pulses will provide which of the following information?

   a. Index and sector train
   b. Sectoring and spindle speed control
   c. Sector count
   d All of the above

2. The "first seek" operation is initiated by what control board signal?

   a. Servo enable
   b. RTZS
   c. Initial seek
   d. SKER

3. What determines where track zero will be written?

   a. The position transducer
   b. FEOT position
   c. The heads load switch
   d. The polarity of the SIN signal

4. While troubleshooting a problem, you determine that the start capacitor is bad. What part number would you use to order a new one?

   a. 77612676
   b. 94255105
   c. 83457601
   d. 94309802

5. During a forward move of the carriage the COS signal will:

   a. lead SIN by 90°
   b. lead SIN by 45°
   (c.) lag SIN by 90°
   d. be 180° out of phase

6. The Error Voltage output of the D/A converter is always:

   a. Negative
   (b) Digital
   c. Stair stepped
   d. Positive

7. What determines the condition of the forward (FWD) signal output from the Drive Signal Generator?

   a. The SIN and COS phase relationship
   b. The carry bit in the ALU
   c. The velocity transducer signal
   d. None of the above

8. In the fine mode of operation when the term "zero" becomes active, what signal does the summing amplifier use as the error voltage?

   a. SIN
   b. $\overline{\text{COS}}$
   c. $\overline{\text{SIN}}$
   d. Either A or C

9. With "Head Select" inputs as indicated, which head is being selected? ($HS^1$ = 1, $HS^0$ = 0) Assume a top to bottom configuration.

   a. Upper head - lower platter
   b. Lower head - lower platter
   c. Upper head - upper platter
   d. Lower head - upper platter

10. What is the primary purpose of the Data Recovery Board?

   a. Separate data and clock pulses
   b. Convert the read data to digital
   c. Monitor for unsafe write current
   d. Separate Index and Sector pulses

11. The definition of a level 3 preventive maintenance is:

   a. Weekly or 300 hours
   b. Annually or 6000 hours
   c. Quarterly or 1500 hours
   d. Monthly or 500 hours

12. In the fine mode of operation, what determines if the SIN or $\overline{\text{SIN}}$ signal is used for final positioning?

   a. Forward signal
   b. $\overline{\text{AD7U}}$
   c. Velocity analog signal
   d. Velocity Cmd. signal

13. Which of the following is an optional feature of the 9427H?

   a. Straddle-erase heads
   b. 2400 RPM's
   c. Fixed disk
   d. 200 TPI

14. In reference to Figure 5-26 of the Hardware Maintenance Manual #77614950, connector A1J14/P14 connects what two assemblies?

a. Power Supply Board #1 to Power Supply Cover Assembly
b. Power Supply Chassis to Blower Assembly
c. Power Supply Chassis to Power Supply Board #1
d. Power Supply Chassis to Brake and Spindle Assembly

15. You are assisting at an installation of a 9427H disk drive. You are given the responsibility to set the fixed disk sector count for 32 sectors. What would be the Sensor mount hole number and SW4 switch set-up you would use?

a. Hole #5 and SW4-6 ON
b. Hole #6 and SW4-6 ON
c. Hole #7 and SW4-5 ON
d. Hole #8 and SW4-2 ON

16. What is the purpose of the STOP OVERRIDE switch selectable option (SW3-1) on the I/O board?

(a.) To disable the stop signal until Unit Select is dropped
b. To allow controller to remotely turn the drive off
c. To disable the Unit for maintenance
d. None of the above

17. The Servo Enable signal is sent from the Control Board on pin #____ to the _____Board.

a. B15, Servo
b. B24, I/O
c. A10, Servo
d. A9, Switch Board

18 If the K1 relay is removed and AIP2 is 180° out of phase from normal operation what will happen?

a. The drive will not do a seek operation
b. The brush motor is disabled
c. Emergency Retract circuit will be disabled
(d.) Both a and c

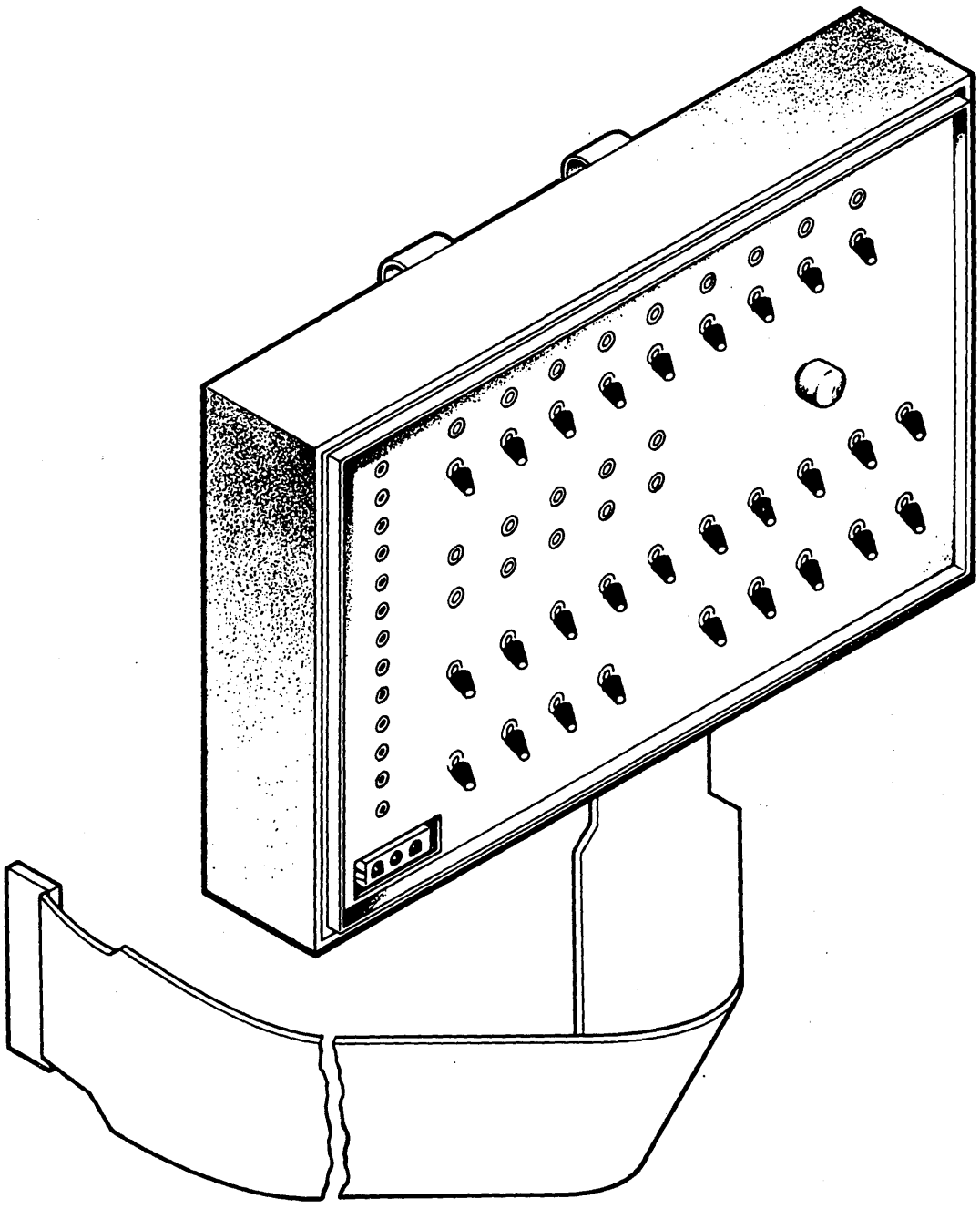
19. How many fuses are required for the 9427H?

a. 3
b. 2
c. 1
(d.) 0

20. What is the purpose of potentiometer R73 on the AGC Servo Preamp?

a. To adjust offset/balance control R74
b. To adjust FEOT sensor
c. To adjust spindle speed
(d.) To adjust the carriage speed for seek timing

# FIELD TEST UNIT TB—118A
# OPERATING INSTRUCTIONS



Small Disk Exerciser

# 1 GENERAL DESCRIPTION

## 1.1 GENERAL

This manual applies to the Small Disk Exerciser TB-118A which is designed as an equipment for exercising the functions of several CONTROL DATA DISK DRIVE types.

## 1.2 APPLICABLE DOCUMENTS

The field manual for the particular drive being exercised should be consulted for assistance in operating the drive under exerciser control as well as for instructions pertaining to adjustments of the drive or help with troubleshooting problems with the drive.

## 1.3 GENERAL DESCRIPTION

The TB-118A Small Disk Exerciser is used to exercise several CONTROL DATA DISK DRIVE types as listed in Table 1-1. The TB-118A exerciser can be used interchangeably on any of the below listed disk drives.

Table 1-1. Small Disk Exerciser Use

| Drive Model | 110 OHM I/O Terminator Drive Capability | 1500 r/min. | 2400 r/min. | Number of Heads Selectable | Unit Active Switch |
|---|---|---|---|---|---|
| 9747 | YES | NO | YES | 20 | NO |
| 9427H | YES | YES | YES | 4 | YES |
| 9414 | YES | YES | YES | 4 | YES |
| 9425/9427 CDD | YES | YES | YES | 4 | YES |

A typical connection between the exerciser and the Electronics Module of a Disk Drive is shown in Figure 1-2.

## 1.4 MAJOR COMPONENTS

The TB-118A includes a component board assembly and front panel housed in a small portable cabinet. The standard interface is 3M connector. In addition, adapters are available to accommodate the Elco, Winchester and Amp type interfaces. It contains no internal power supply, but 50 Hz and 60 Hz Power Supplies are available. All electrical components are mounted on the component board. A faceplate with silkscreened legends identifies each Switch, Indicator, and Test Point.

Plastic handles are mounted on the back of the unit to permit attachment of the exerciser to the Disk Drive being exercised.

The dimensions of the portable cabinet in which the exerciser component board is mounted are 10.0 in. (254 mm) by 8.61 in. (218 mm) by 1.50 in. (38.1 mm). See Figure 1-2.

## 1.5 POWER REQUIREMENTS

The Exerciser obtains +5V operating power from the external power supply. Current requirement is approximately 1.2 amps. The exerciser will exercise only one disk drive at a time.

### 1.5.1 EXTERNAL POWER SUPPLY

50 Hz and 60 Hz power supplies are available to provide +5V operating power to the TB-118A. The supply is not capable of providing Termination power at the drive end.

The input power requirements for the two units are as follows:

| | |
|---|---|
| 50 Hz Power Supply | Input Voltage: 198 - 246 VRMS<br>Input Frequency: 49.0 - 50.5 Hz |
| 60 Hz Power Supply | Input Voltage: 104 - 127 VRMS<br>Input Frequency: 59.0 - 60.6 Hz |

Each power supply is provided with a 48 in. (1.2 m) long output cable.

## 1.6 INTERFACE

### 1.6.1 INPUT/OUTPUT CABLES AND ADAPTERS

1. Cables

Two Input/Output cables are available to accommodate the various interface types. Both cables are 48 in. (1.2m ) long. One cable accommodates the device interface using the 3M connector. The other cable is used to interface the exerciser with each of the various adapters that are available.

2. Adapters

Five adapters are available. There is an adapter for each of the Elco, Amp or Winchester interface connectors, plus, there are dual adapters for Elco and Winchester connectors, which also pick up internal device power for terminators on the 9425/27 CDDS. The latter adapters are also mechanically different from the others.

## 1.6.2 POWER CABLES

Two +5V power cables are available for providing power to the terminators on the terminator 9425/27 CDDS. The cable accommodates the two types of CDD Power connectors. One cable accommodates the Molex connector ont he rear of the device, and the other cable accommodates the IC socket on the Digital Board.

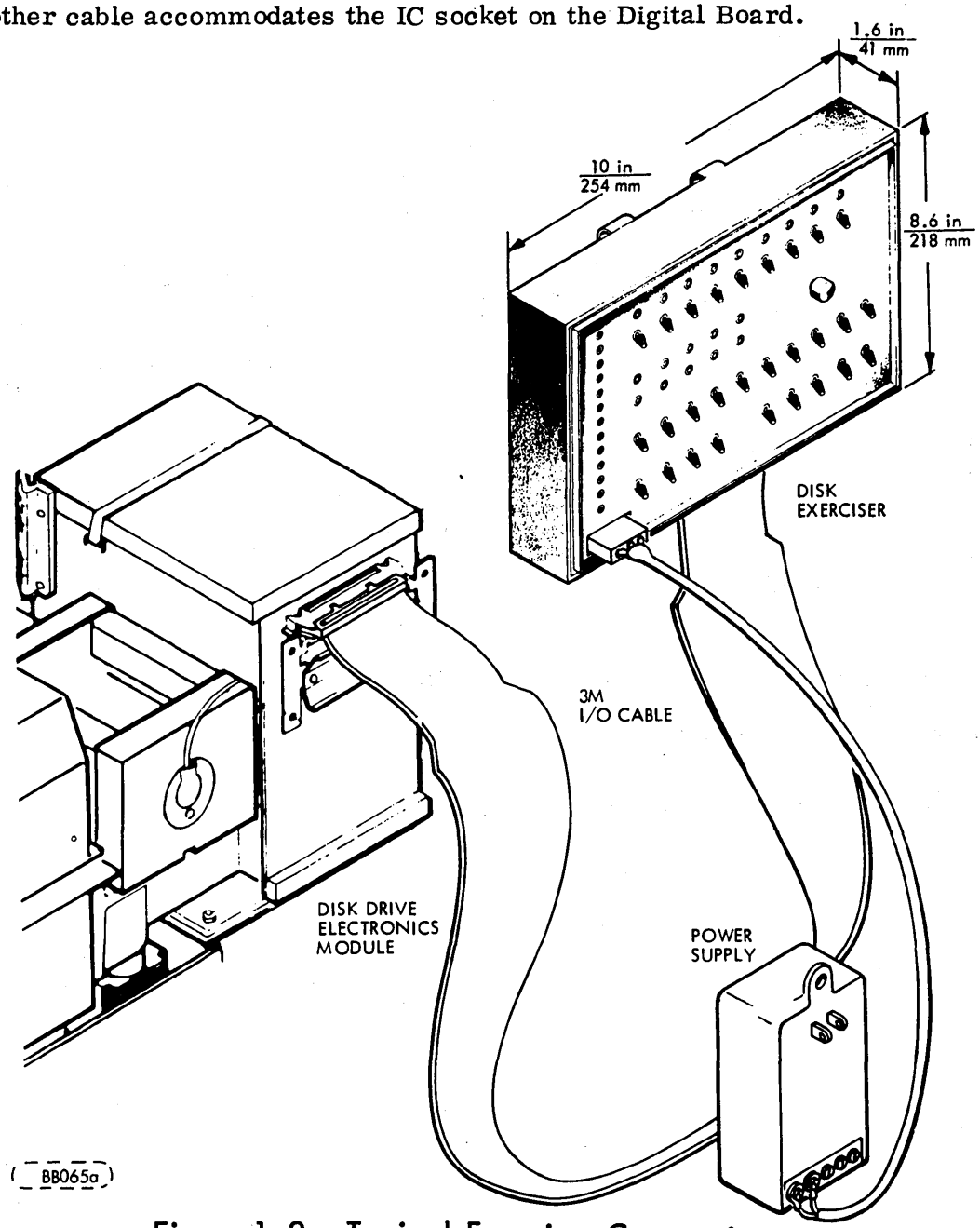



Figure 1-2. Typical Exerciser Connection

# II
# OPERATION

## 2.1 GENERAL

The exerciser is a tool used by maintenance personnel in the maintenance or repair of a disk drive. The exerciser may be used in conjunction with the fault isolation and retention circuits of the unit being exercised.

### 2.1.1 GENERAL OPERATION PROCEDURES

1. Before the maintenance personnel can use this tester, they should be aware of how the unit under test is configured. The following switches should be preset to conform to the configuration of the unit under test. Refer to section 2.2.1 switches for switch definition.

   - U SEL (Unit Selected)
   - Soft/Hard (Sector)
   - 1500/2400 (r/min)
   - DF/NRZ (read and/or write data)
   - 100/200 (TPI)
   - $HD2^0$, $2^1$, U ACT or $2^2$, HD3 and HD4 (Head Select)

**CAUTION**

Before writing insure that customer files have been removed and that the media to be used is allocated for maintenance purposes.

2. Before performing a read data check, write the entire surface in SEQ REV mode with the maximum cylinder address of the disk drive being exercised set into the ADDRESS switches. Set the SQ STP switch after pressing the GO switch. The exerciser will halt after the entire disk has been written.

3. Other seek modes may be used to write disk surface but attention must be given to the addressing range provided by each seek mode.

## 2.1.2 GENERAL CHARACTERISTICS

The following paragraphs describe overall characteristics applicable to the operation of the exerciser.

1. When writing a surface in Sequence Forward mode make a minimum of two passes to insure that every track is written. (Track 000 will not be written on the first pass because the sequence starts at track 001).

2. To terminate a WRITE function properly before performing a Read Data Check, put the SQ STP Switch in SQ STP position. Wait till the exerciser finishes the sequence it is performing, then put the WRITE/ACCESS/READ switch in READ position. A WRITE function can also be stopped by turning the SK CNT switch, off.

3. In Random modes, if the exerciser stops because a Read Error was detected, the Address Indicator will probably not display the address of the track on which the error occurred, because the Random Address Generator runs while the Disk Drive is On Cylinder. In other modes the address of the track where the error occurred will be displayed.

## 2.2 CONTROLS AND INDICATORS

See Figure 2-1.

### 2.2.1 SWITCHES

Twenty nine switches are provided to permit the operator to select and control exerciser functions:

1. PWR - (power switch) applies +5V power to the exerciser in the PWR position.

2. Rotary Function Switch - enables the operator to select the following functions:

   a. DRT SK (direct seek)- The actuator seeks the track selected by the Address switches when the GO Switch is pressed. Subsequently, if the SK CNT switch is in the up position, the actuator position may be changed by selecting another track with the ADDRESS switches without pressing the GO switch.

   b. ALT SK (alternate seek)- The actuator alternately seeks the track selected by the address in the internal register of the exerciser and the track selected by the Address switches.

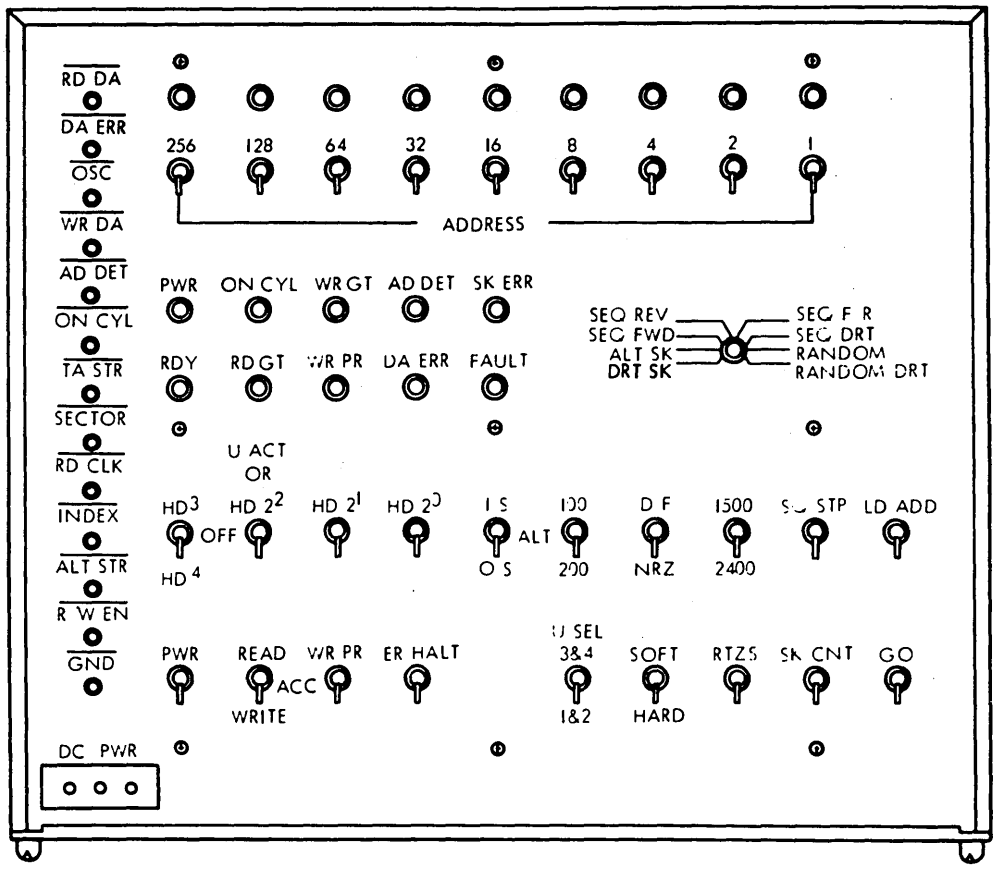



Figure 2-1. Controls and Indicators (Typical)

c. SEQ FWD (sequence forward)- The actuator seeks sequentially one track at a time forward from track 0 to maximum track* on first pass, and from track 00 to maximum track* on successive passes.

d. SEQ REV (sequence reverse) - The actuator seeks to an address selected by the ADDRESS switches then sequentially one track at a time back to track 00.

e. SEQ F/R (sequence forward reverse) - The actuator seeks sequentially one track at a time from track 0 to maximum track* and then sequentially one track at a time back to track 00.

f. SEQ DRT (sequence direct) - The actuator seeks alternately between the sequence forward reverse function and the address selected by the address switches.

g. RANDOM - The actuator repetitively seeks random addresses. The SK CNT switch must be in the UP position and the SQ STP switch must be DOWN to perform this function. If doing a read or write function, and a read error halts the operation, the ADDRESS indicators will not contain the address at which the error occurred because the random address generator runs while on cylinder and not read gate. Tracks 0 through $403_{10}$ ($623_8$) will be accessed on a 200 TPI drive. Tracks 0 through $201_{10}$ ($311_8$) will be accessed on a 100 TPI drive.

h. RANDOM DRT (random direct) - The actuator seeks alternately between the random function and an address selected by the ADDRESS switches.

3. HARD/SOFT switch - Enables the operator to select the proper format pattern for hard sector or soft sector disk drives.

4. $Hd2^2$ or U ACT (unit active) switch - U ACT is used only when exercising drives with this optional line. The U ACT position enables the unit active line. $Hd2^2$ is used only in selecting Head $2^2$ on the 9747 disk drive.

5. U SEL 3 & 4/1 & 2 (unit select) switch - Enables the operator to select either unit select lines 1 and 2, or 3 and 4.

6. 100-200 (100 or 200 tracks per in.) switch - Enables the operator to select the proper address range for the disk drive being exercised.

7. ADDRESS switches - Nine toggle switches enable the operator to select a desired address in binary.

8. SK CNT (seek continuous) switch - In the SK CNT position enables the exerciser to perform alternate or sequential seek functions continuously. In the down position of the switch these functions are single stepped each time the GO switch is depressed. If a read or write function is being performed on a given track address the read or write gate can be held on with the switch in the down position. If the switch is in the up position the gate will drop on alternate revolutions to enable a new seek command.

*Track $403_{10}$ ($623_8$) on a 200 TPI drive or to track $201_{10}$ ($311_8$) on a 100 TPI drive.

9. RTZS (return to zero) switch - Initiates a return to track 00 when depressed and released.

10. GO switch - Initiates the function that has been selected on the seek function rotary switch when depressed and released.

11. LD ADD (load address) switch - Causes the address selected on the ADDRESS switches to be entered into the exerciser internal register as an alternate address when depressed.

12. HD $2^0$ $2^1$ $2^2$ $2^3$ $2^4$ (head switches) - These switches enable the operator to select, in binary, the head to be exercised. Head $2^2$, $2^3$ and $2^4$ switches are provided for 9747 units.

**CAUTION**

Head switches should be left in center position for all other devices.

13. READ/ACCESS/WRITE switch - Enables seek function only in the ACCESS position. When in the READ or WRITE positions the read or write gate is switched on for one revolution at index time then off for one revolution at the next index time.

    In a Sequential Seek Mode, Track 0 and 404 are never written on the first pass. Track 0 will be written on the second continuous pass. Track 404 can only be written by using the Direct Seek Mode to track 404 and write.

14. 1's/Alt./0's switch - Enables the operator to write either 0's or 1's or an alternating 1, 0, pattern in the data field.

15. WR PR (write protect) switch - Causes the disk drive being exercised to be write protected in the WR PR position provided the I/O write protect option is installed in the disk drive.

16. ER HALT (error halt) switch - Causes the exerciser to stop in the event of a seek, length, timing, or data error when in the ER HALT position. Data errors will not be detected if an address mark is not detected before the data field.

17. SQ STP (sequence stop) switch - In the SQ STP position this switch causes the exerciser to stop at track 00 after one pass of a sequence mode.

18. 1500/2400 switch - This switch changes the write data oscillator from 640 ns cell time at 1500 r/min to 400 ns cell time at 2400 r/min.

19. NRZ/DF switch - This switch permits the transfer of either NRZ or double frequency write/read data across the interface. See timing diagrams in Figures 2-2, 2-3 and 2-4.

## 2.2.2 INDICATORS

Nineteen Light Emitting Diodes indicate status of the exerciser and the equipment being exercised.

1. PWR (power - LED10) Illuminates when the correct polarity voltage is applied to the exerciser.

2. RDY (ready - LED15) Illuminates when disk unit is ready for exercising.

3. ON CYL (on cylinder - LED11) Illuminates when the heads are positioned on track.

4. RD GT (read gate - LED16) Illuminates for the duration of a read function.

5. WR GT (write gate - LED12) Illuminates for the duration of a write function.

6. WR PR (write protect - LED17) Illuminates when the unit being exercised is write protected.

7. AD DET (address detected - LED13) Illuminates when in the read mode, when a single "1" address mark is detected prior to the data field. A data error may be missed if no address mark is detected.

8. DA ERR (data error - LED18) Illuminates when an incorrect bit has been detected in the data field, after an address mark is detected. A data error may be missed if no address mark is detected.

9. SK ERR (see error - LED14) Illuminates when a seek error is indicated by the unit being exercised.

10. FAULT (LED19) - Illuminates when a fault condition occurs on the unit being exercised.

11. ADDRESS - Nine indicators (LED 1 through LED 9) indicate the destination address in binary values $2^0$ through $2^8$ respectively.

## 2.2.3 TEST POINTS

Thirteen convenient test points on the face of the Exerciser provide easy access to signals from the Disk Drive or the exerciser. These Test Points are listed on the following page.

## Table 2-1. Test Points

| T.P. LABEL | SIGNAL NAME | SOURCE | | COMMENT |
|---|---|---|---|---|
| | | DRIVE | EXERCISER | |
| RD DA | READ DATA | X | | |
| DA ERR | DATA ERROR | | X | |
| OSC | OSCILLATOR | | X | 5MHz for 2400 r/min Drives 3.125 MHz for 1500 r/min Drives. |
| WR DA | WRITE DATA | | X | |
| AD DET | ADDRESS DETECTED | | X | |
| ON CYL | ON CYLINDER | X | | |
| TA STR | TRACK ADR STROBE | | X | |
| SECTOR | SECTOR PULSE | X | | |
| RD CLK | READ CLOCK | X | | |
| INDEX | INDEX PULSE | X | | |
| ALT STR | ALTERNATE STROBE | | X | Used in alternate seek, sequence direct, and random direct modes |
| R/W EN | READ/WRITE ENABLE | | X | |
| GND | SIGNAL GROUND | X | X | |

# III
# INSTALLATION AND CHECKOUT

## 3.1 NORMAL INSTALLATION

The TB-118A Small Disk Exerciser is designed to be used on Disk Drives which are disconnected from the operating system. A separate sub-section is provided which explains the details of installation and checkout for each different type disk which can be exercised by the TB-118A. There are as follows:

3.1.1 The 9425, 9427 CDD
3.1.2 The 9427H
3.1.3 The 9414
3.1.4 The 9747

Refer to Table 3-1 which relates Disk Drive and Device configuration to adapter and power supply accessories required.

Figure 3-1 illustrates the two methods of connecting the Exerciser to the Disk Drive. Not shown is the connection to the external power supply which is required for operating the Exerciser.

## 3.1.1 INSTALLATION FOR 9425, 9427 CDD UNITS

1. Switch the Disk Drive Main AC Circuit Breaker (located at the rear of the power supply) OFF. Disconnect the Disk Drive from the Operating system, thus making the I/O connector available.

2. Connect the proper I/O Adapter to the Disk Drive I/O connector (see Figure 3-1B).

3. Connect the Exerciser I/O cable to the adapter.

4. Connect the Exerciser to the external +5V power source.

5. The Disk Drive to be exercised must have an I/O Terminator and a Terminator Power Source. The CDD may use or already have either the internal terminator on the Digital Board or the external terminator at the rear of the unit. The I/O adapter for either Elco or Winchester type interface are unique for the 9425/27 CDD. These adapters have provision for use of one of two power cables which pick up internal device power for either the internal terminator via an IC socket or for the external terminator via a Molex connector.

6. Apply power to the Exerciser and the Disk Drive and begin exercising the unit.

## 3.1.2 INSTALLATION FOR 9427H UNITS

1. Switch the Main AC Circuit Breaker (located at the rear of the unit) OFF. Disconnect the Disk Drive from the operating system, thus making the I/O connector available.

2. When the Exerciser is connected to the unit, terminator power should be supplied by the unit. If the unit I/O board is set up so that terminator power is taken from the interface cable, consult the unit maintenance manual, I/O Board switch spec, for information on changing the source of terminator power. See also Figure 3-2 which shows a typical I/O Board for 9427H units.

**CAUTION**

Attempting to operating the 9427H Disk Drive from the Exerciser with the terminator power being drawn from the interface cable will cause a "hard" fault in the Disk Drive. To recover, the Disk Drive must be powered down, the terminator power source switched so that terminator power comes from the Disk Drive, and the power restored to the Disk Drive.

3. Connect the Exerciser I/O cable directly to the drive if it has a 3M I/O connector or to one of three I/O adapters if it has other than 3M. See Figure 3-1.

# Table 3-1. Disk Drive/Interface Adapter/Power Cable Requirements

| DEVICE CONFIGURATION | | | | | | | | | I/O CABLE AND ADAPTER | | | | | | | ADAPTER POWER CABLE | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEVICE | | | | | DEVICE I/O CONNECTOR | | | | I/O CABLE | | I/O ADAPTER | | | | | | | |
| 9425/27* | 9425/27** | 9427H | 9747 | 9414 | ELCO | AMP | 3M | WINCHESTER | FIG. 3-1A | FIG. 3-1B | ELCO | AMP | WINCH. | ELCO I PWR CBL | WINCH I PWR CBL | 3-PIN TO DEV. | 14-PIN TO DEV. | NO REQUIREMENT |
| X | | | | | X | | | | | X | | | | X | | X | | |
| | X | | | | X | | | | | X | | | | X | | | X | |
| X | | | | | | | | X | | X | | | | | X | X | | |
| | X | | | | | | | X | | X | | | | | X | | X | |
| | | X | | | X | | | | | X | X | | | | | | | X |
| | | X | | | | X | | | | X | | X | | | | | | X |
| | | X | | | | | X | | X | | | | | | | | | X |
| | | X | | | | | | X | | X | | | X | | | | | X |
| | | | X | | X | | | | | X | X | | | | | | | X |
| | | | X | | | | | X | | X | | | X | | | | | X |
| | | | | X | X | | | | | X | X | | | | | | | X |
| | | | | X | | X | | | | X | | X | | | | | | X |
| | | | | X | | | X | | X | | | | | | | | | X |
| | | | | X | | | | X | | X | | | X | | | | | X |
| | | | | | | | | | | | | | | | | | | |

*UNITS WHICH HAVE A 3-PIN RECEPTACLE ON BACK PANEL OF DEVICE FOR EXERCISER POWER.
**UNITS WHICH HAVE NO RECEPTACLE ON DEVICE BACK PANEL FOR EXERCISER POWER. POWER CABLE FOR EXERCISER IS PLUGGED ONTO THE WIRE-WRAP PINS OF ANY 14-PIN IC SOCKET ON THE DIGITAL BOARD.

BB082a

NOTE: ALL DEVICES REQUIRE THE EXTERNAL POWER SUPPLY TO POWER THE EXERCISER. PART NUMBER FOR THE 60 Hz MODEL IS 75835190, AND PART NUMBER FOR THE 50 Hz MODEL IS 75835180.

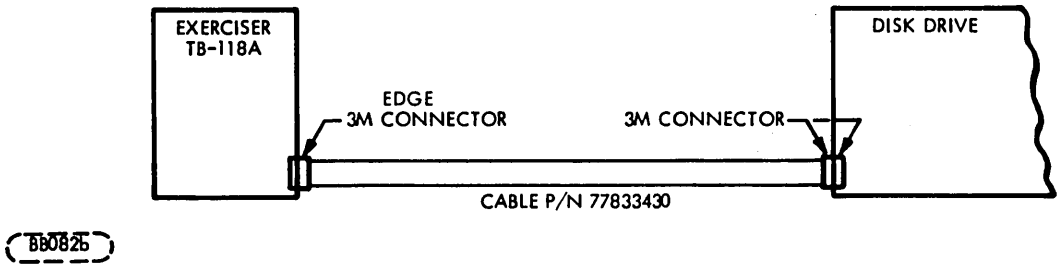



Figure 3-1a. Exerciser - Disk Drive Signal Cable Arrangement for 3M to 3M Interface

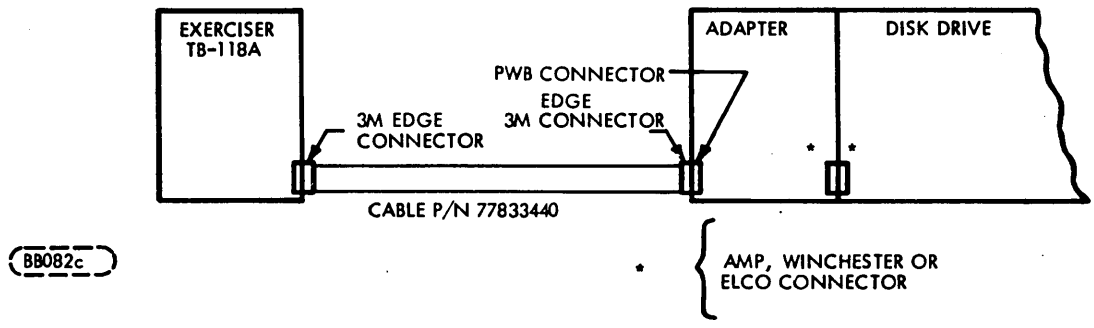



Figure 3-1b. Exerciser - Adapter - Disk Drive Signal Cable Arrangement for 3M to Elco/Winchester/Amp Interface

**CAUTION**

If an external terminator block is used HD2[3]/2[4] switch on the Exerciser must be in the center (OFF) position, or a voltage fault will occur on the device.

4. Connect the Exerciser to the external power supply. J3 on the I/O Board does not provide adequate power for the TB118A Exerciser.

5. Apply power to the Disk Drive and refer to section 2.1 for operation instructions.

6. Before returning the 9427H Disk Drive to service restore the terminator power source connection to its normal state. (See I/O Board Switch Spec in maintenance manual.)

## 3.1.3 INSTALLATION FOR THE 9414 DISK DRIVE

1. Switch the Disk Drive main AC power off at the optional power supply chassis.

2. Disconnect the Disk Drive from the operating system, thus making the I/O connector available.

3. Connect the Exerciser I/O cable directly to the drive if it has a 3M I/O connector, or connect it to one of the three I/O adapters if the drive has other than a 3M connector. Refer to Table 3-1 and Figure 3-1.

4. If applicable, connect the adapter to the Disk Drive using the regularly installed I/O cable.

5. Connect the Exerciser power cable to the external Power Supply.

6. Refer to Figure 3-3. Switch S-1 should be placed in the upper position so that terminator power is provided by the Disk Drive.

7. Install a terminator board in the proper I/O connector.

8. Apply power to the Disk Drive and the Exerciser and begin exercising the unit.

NOTE

The systems having I/O adapters for the 9414 may disconnect the adapters and connect the exerciser per Figure 3-1a.

## 3.1.4 INSTALLATION FOR THE 9747 DISK DRIVE

1. Switch the Disk Drive main AC power off at the drive main AC circuit breaker.
2. Disconnect the Disk Drive from the operating system at the Drive end, thus making the I/O connector at the drive available for connecting to the I/O adapter that is in turn connected to the Exerciser.
3. Connect the exerciser I/O cable to the proper adapter and connect the adapter to the Disk Drive I/O connector.
4. Connect the Exerciser power cable to the external power supply.
5. If terminators are not present on the I/O Board, they should be installed.
6. Apply power to the Disk Drive and the Exerciser and perform exercises as required.

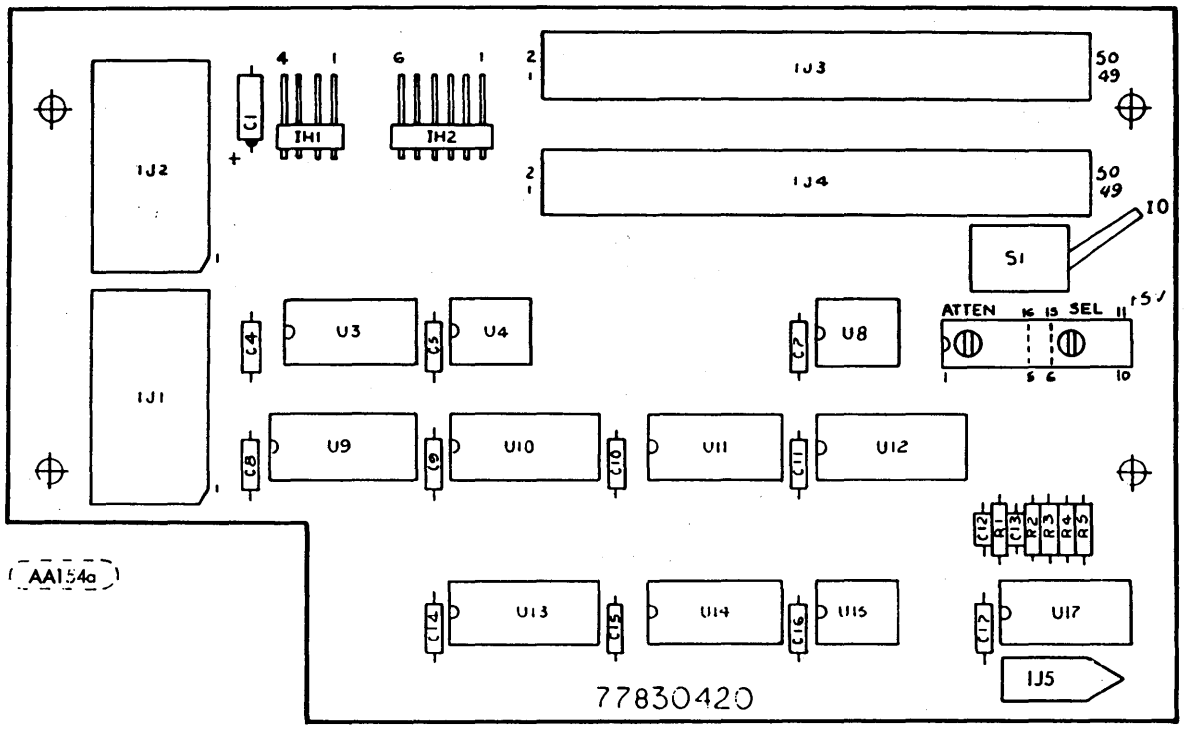
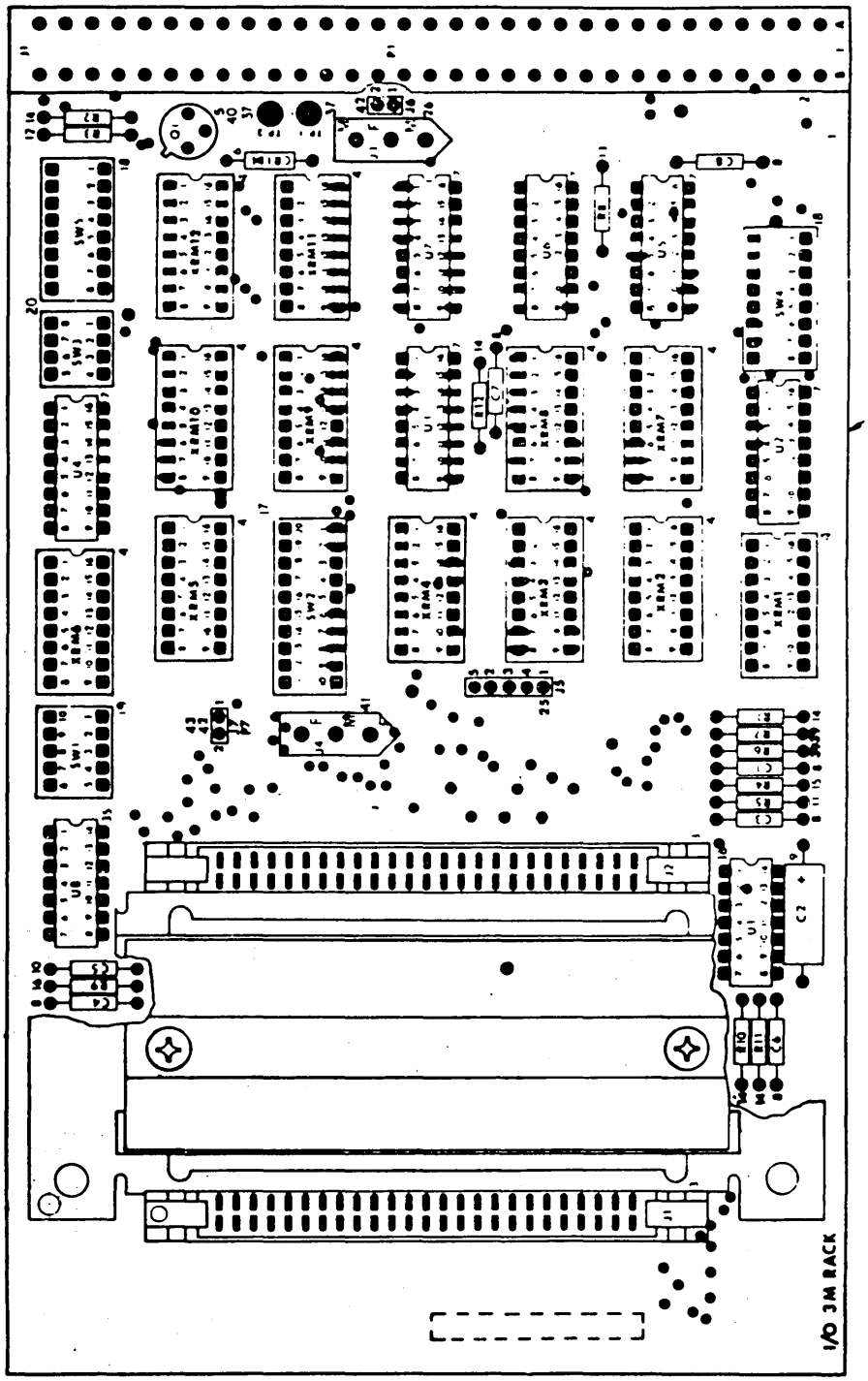
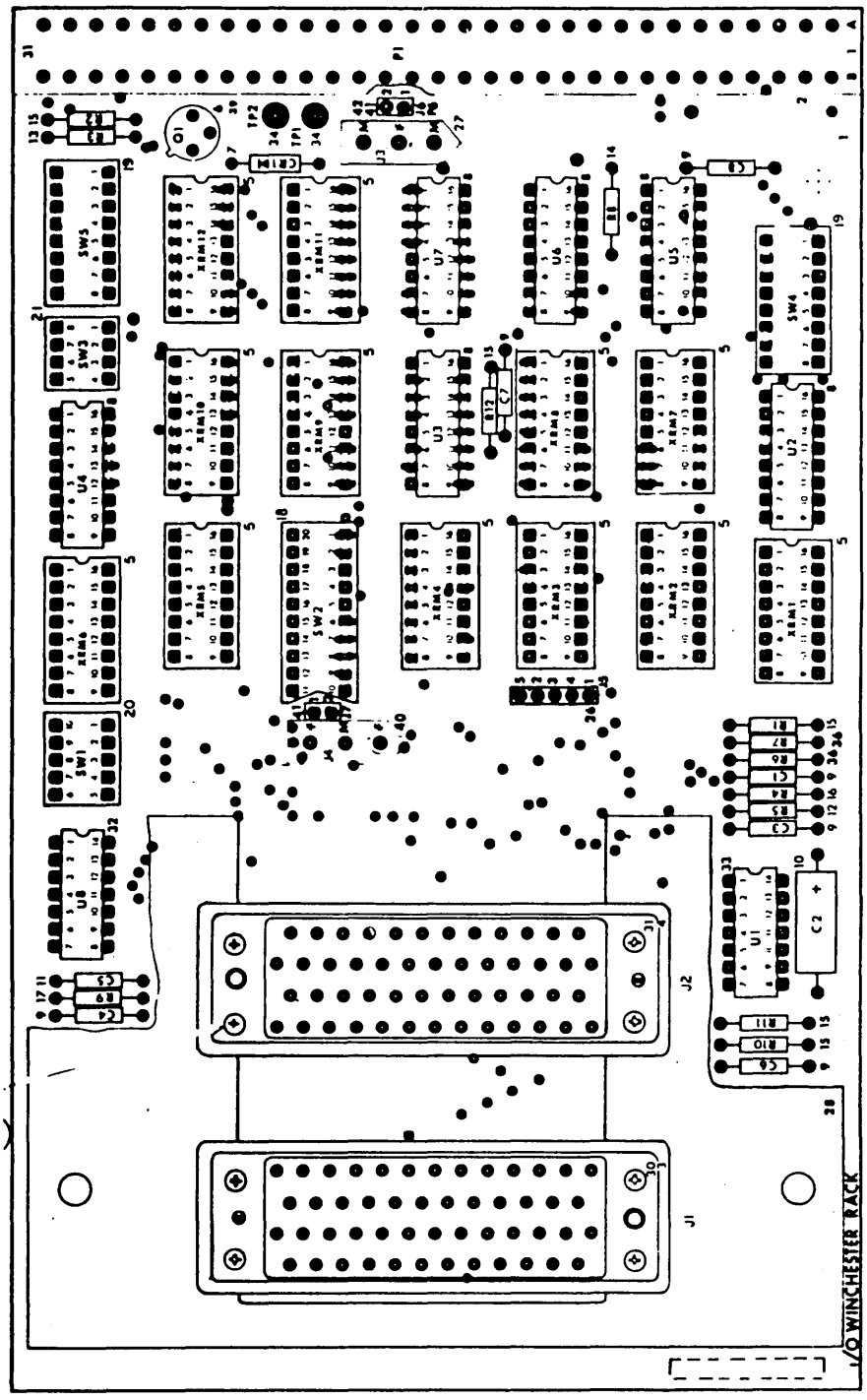


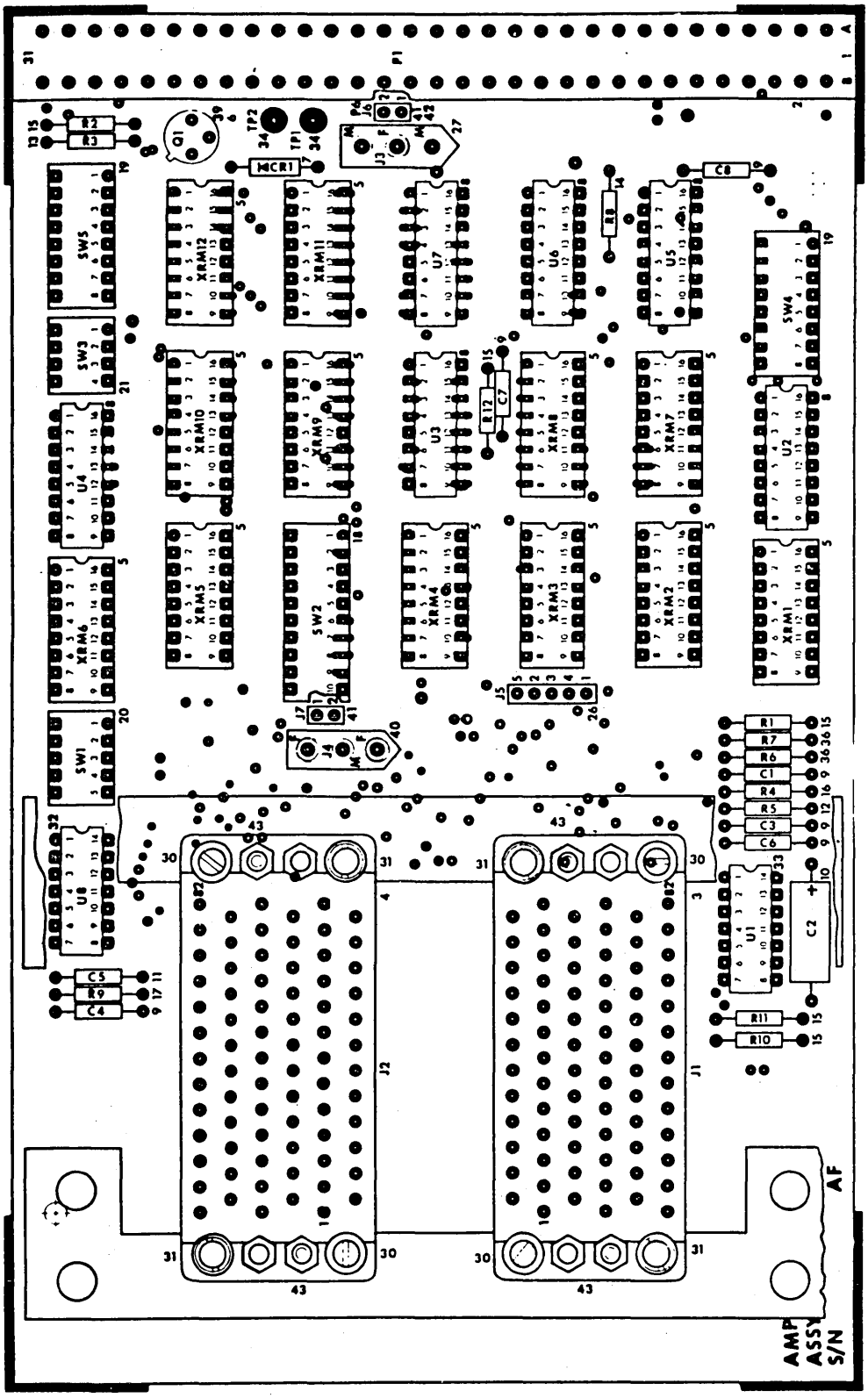

Figure 3-3. 9414 Disk Drive I/O Board



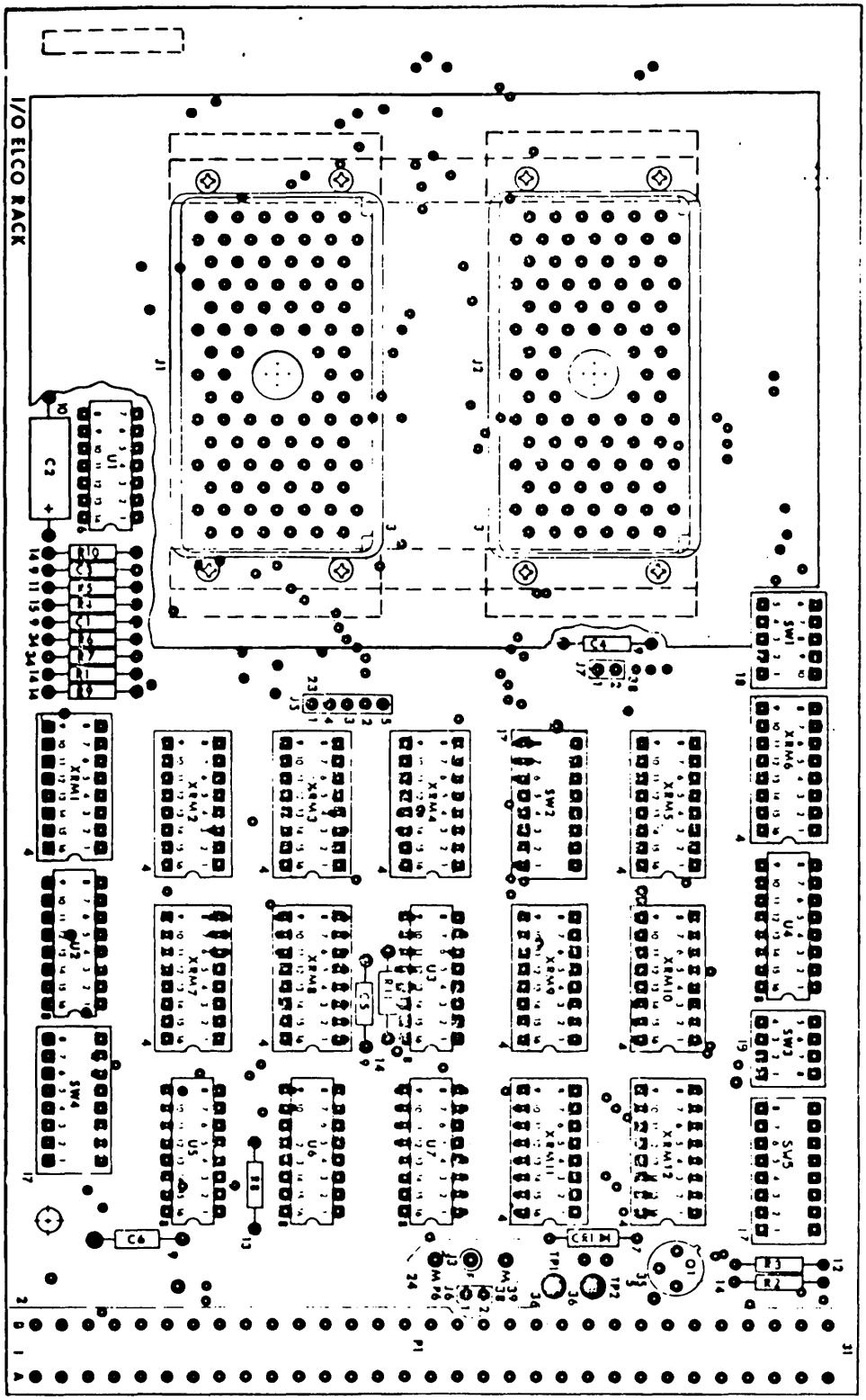

3M - I/O BOARD (RACK)




WINCHESTER I/O BOARD (RACK)




AMP I/O BOARD (RACK)




ELCO I/O BOARD (RACK)

# COMMENT SHEET

MANUAL TITLE 9427H CARTRIDGE DISK DRIVE

PUBLICATION NO. 75445721 REVISION A Prod. No. H1020

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BUSINESS ADDRESS:

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